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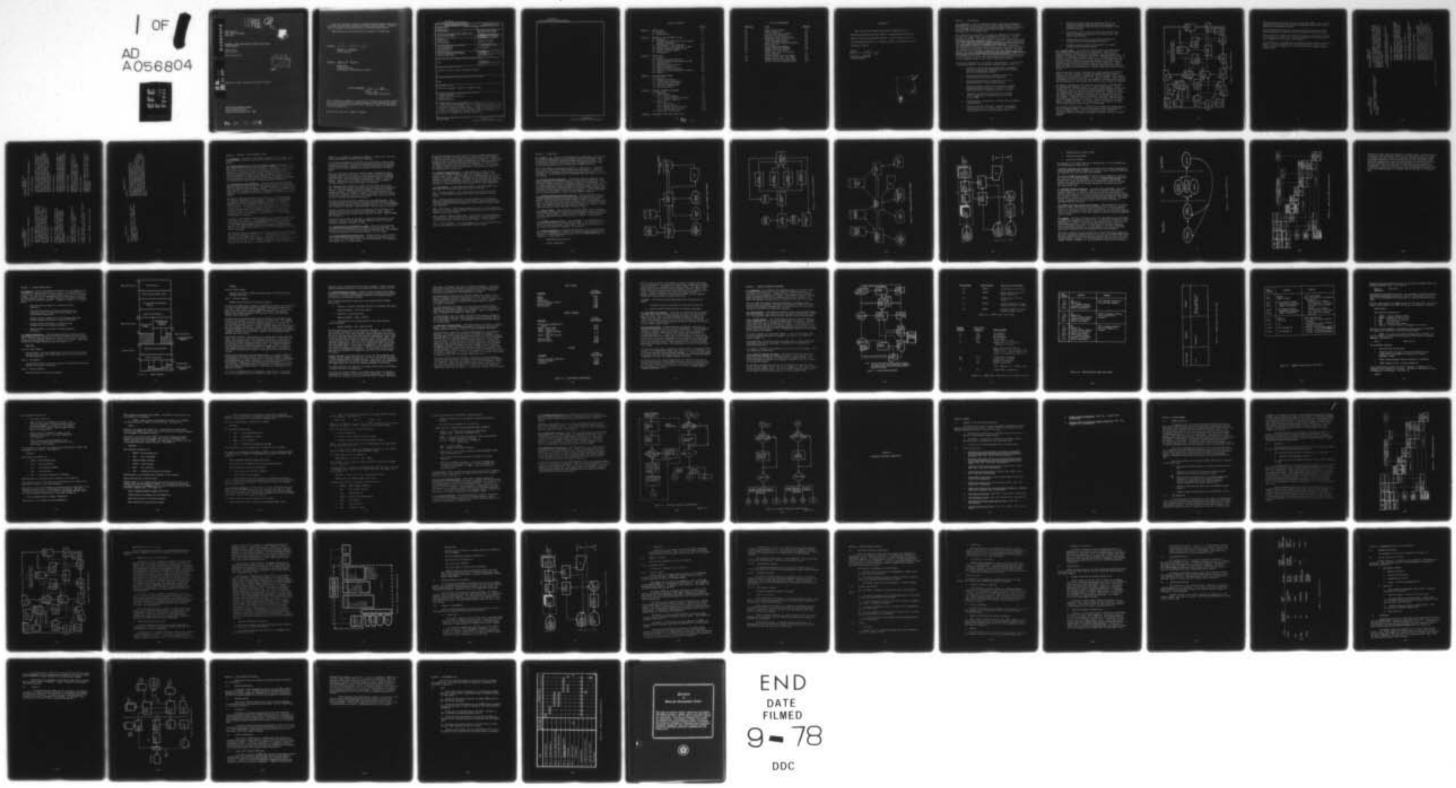

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RADC-TR-78-119
Final Technical Report
June 1978

AUTOMATED INTELLIGENCE PROCESS EXERCISE AND REVIEW SYSTEM (AIPERS)

Robert Slaski
Jeffrey Kessler

INCO, Incorporated

Approved for public release; distribution unlimited

ROME AIR DEVELOPMENT CENTER
Air Force Systems Command
Griffiss Air Force Base, New York 13441

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This final technical report is written to document the results of current contractural efforts for AIPERS. With this documentation the feasibility of developing an operational automated exercise system is realized with two subsystems. In particular, the report includes a summary of system and software performance improvements, and suggested future goals. Also included as Appendix A is the AIPERS/SSB functional description.

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EVALUATION

This report covers completion and initial demonstration of a Demonstration Utility Prototype (DUP) of a stand-alone Computer-based system to exercise intelligence analysts. It will support exercise of the intelligence function in a realistic fashion in accordance with DoD Instruction 5100.30.

PATRICIA M. LAGENDORF
Project Engineer

SECTION 1. INTRODUCTION

1.1 Background. This Final Technical Report is written to document the results of the contractual effort for Contract Number F30602-77-C-0044, the enhancement of the Automated Intelligence Processes Exercise and Review System (AIPERS) Demonstration Utility Prototype (DUP), for the period 16 January 1977 to 15 January 1978.

This publication is the fourth in a series of technical reports prepared by INCO, INC., which defines the specifications of the components and functions of AIPERS. The initial document in the series was titled, Intelligence Exercise Generation Concept, 1 April 1974. The second document was titled, Exercise Generation Concept Improvement: Technical Definitions and a Development Plan for an Automated Exercise System, 30 June 1975, and was subsequently published as RADC-TR-75-252. With this documentation, the feasibility of developing and automated exercise system was established and a generalized operational concept for AIPERS was produced. The third document was titled, Automated Intelligence Processes Exercise and Review System, Functional Specifications and Prototype Development, F30602-75-C-0283, Final Report, 11 June 1976. This publication presented the specifications of the components of the DUP exercise system which were developed as well as the functional design of the scenario generation subsystem.

To place the current effort in context of past endeavors, a concise review of the latter follows. In the previous technical reports, INCO, INC.:

- o Detailed the Indications and Warning (I&W) intelligence processes, products and interfaces with other functional areas and informational resources.
- o Presented the objectives of exercises and exercise systems derived from official documentation.
- o Developed methodologies for exercising the intelligence processes on a non-interference basis.
- o Evolved evaluation criteria for an automated exercise generation system which were in concert with the defined objectives of exercises and exercise systems.
- o Identified the body of state-of-the-art technology which is applicable to the design and structuring of the AIPERS.
- o Highlighted the critical areas of design work for research and development.
- o Prepared a detailed development plan and an implementation schedule for the exercise system. The prototype programs were developed and they were documented.

- o Provided functional design specifications for exercise control and tracking functions and the methodology for performing tracking. These functions were included in the exercise prototype.

- o Articulated initial concepts for employing decision impact analysis regarding the assessment of scenario event stimulated human responses.

- o Accomplished an analysis of and evolved procedures for exercise operations and management functions.

- o Provided functional design specifications for scenario generation with automated assists.

1.2 Current Status. As a result of the development performed during this contract, two subsystems are now demonstrable. These are the Scenario Generator and the Exercise subsystems. These subsystems are linked via the Message and Resource File and the Message Time List file. An overview of the system is shown in Figure 1-1. The three modules of the Scenario Generator subsystem, the Library Manager, the Scenario Selection Processor, and the Scenario Formatter were written during this contract period from specifications developed during previous contracts. Enhancements were made to the modules of the Exercise Subsystem, the Exercise Control Processor and the Publisher, to provide a more efficient and stable system.

Using the Scenario Generator subsystem, the system manager can create and update a data base containing categorized messages from which exercise scenarios can be developed. At generation time the messages can be chosen selectively (by keyword) and added to the exercise scenario. Other exercise requirements, such as message time tag, resources, and anticipated responses are also entered into the scenario data files for access during the exercise.

The Exercise subsystem has the capability of supporting a variable number of user/analysts terminals along with a control team terminal. These terminals may be any TTDL supported terminal including teletype and IBM 3270. In testing to date, an exercise with two user/analyst terminals has been run, demonstrating this multi-user/analyst capability. During an exercise, the control team is informed of the status via a distribution display at the terminal. Using this status information, the control team can alter the scenario to customize the scenario to the conditions. Tracking information is logged detailing all actions - system, user/analyst, or control team - during the exercise. This logged data is to be used as the input for the post-exercise analysis, when it is developed.

The operation and maintenance of AIPERS has been simplified through development of command streams. A start-up procedure has been developed where one input command invokes the required command stream. Similarly, procedures have been developed to assemble, task build, or list the AIPERS modules.

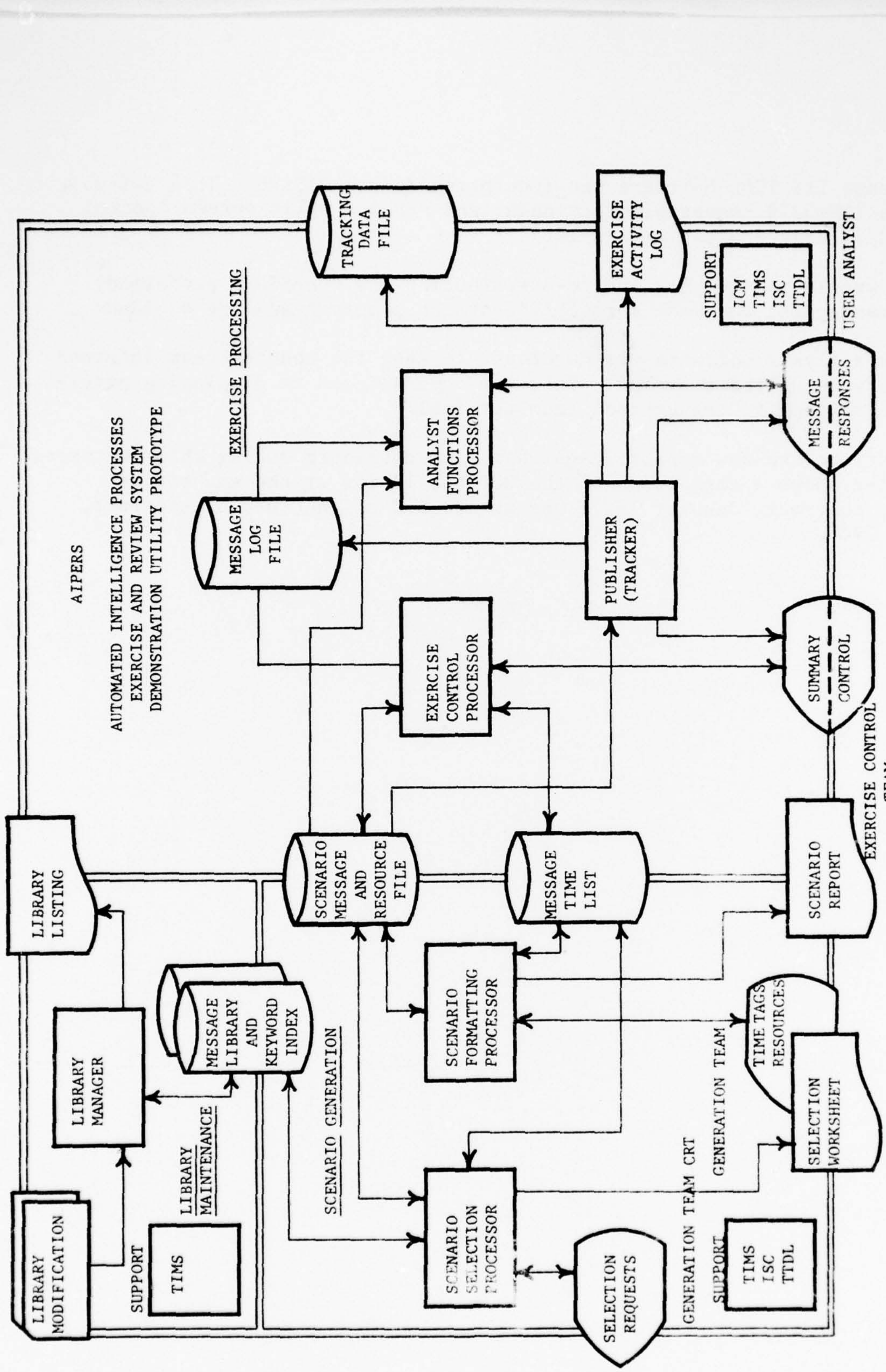


Figure 1-1. AIPERS System Overview

SSB Release III TTDL Software was incorporated into AIPERS. This software supports IBM-3270 compatible terminals, and permits split screen control team and/or user/analyst terminals.

Through overlaying modules and re-distributing the functions performed, memory management was made more efficient and memory dead-lock avoided.

Decision analysis software was developed to keep the control team informed of the status of the exercise. This was accomplished by displaying pertinent information to the control team terminal.

To illustrate the new capabilities that were developed during this contract, Figure 1-2 shows a comparison of the DUP facilities at the end of the previous contract, January 1977, and at the end of the current contract, January 1978.

JANUARY 1977

Scenario Generation

Functional Description and working data base description completed. No software developed.

JANUARY 1978

Scenario Generation

Software development and testing completed. Full prototype capability established. Program documentation completed. Enhanced operational capabilities include command abbreviations with optional HELP menus, and arbitrary, repeatable execution steps.

Subsystems specifications for operational AIPERS published as preliminary draft.

- Library Manager.

  Extended Capabilities include multi-mission message libraries, and generalized message categorization scheme. Designed for expedient High Level Language (Structured FORTRAN) implementation.

- Scenario Selection Processor.

  Enhanced Subsystem Specification capability includes multi-mission library access.

- Scenario Formatting Processor.

  Enhanced Subsystem capabilities include message routing to multiple, arbitrary destinations, multiple extended user/analyst resources classifications, definition of timed system responses for user/analyst queries, more sophisticated response prediction for decision analysis, and threshold criteria definition for automatic conditional message distribution.

Figure 1-2. AIPERS Comparison

JANUARY 1977

Exercise Subsystem

Functional description completed.

- o Control Processor.

  Software developed. Intermittent Message Time List (MTL) update errors resulting from timing problems occurred. Potential for deadlock due to MTL file access contention existed. Constructed modularly but not structured in MACRO-11. Maintained MTL as strictly sequential file (ordered by time.)

- o Scenario Processor.

  Software developed. Constructed with no support software error checking and unnecessary, contorted queue-driven design. Used discrete time message scheduling resulting in late message publication.

- o Tracker.

  Software developed. Constructed with no support software error checking and contorted queue driven disign.

- o Analyst Processor.

  Software developed. Constructed as separate modules for each analyst station.

JANUARY 1978

Exercise Subsystem

Subsystem Specification being prepared

- o Control Processor.

  Expanded to include message scheduling on a real time (event-driven) basis and queue MTL update rather than sequential procedures. Replaced scenario processor by incorporating scheduling functions, resulting in overall memory reductions and alleviating deadlock and timing problems. Rewritten in structured Macro format. Overlayed to memory requirements.

- o Scenario Processor.

  Functions delegated to control processor and publisher, resulting in smoother system operation and reduced memory requirements, as well as eliminating problems with file contention and task checkpointing (deadlock).

- o Publisher (tracker).

  Expanded to include decision analysis. Design modified to eliminate internal queue. Error checking included. Enhanced to incorporate message publication.

- o Analyst Processor.

  Single module created to be used by several user/analysts. (Not re-entrant, simply self-identifying.) Overlayed to reduce memory requirements.

Figure 1-2. AIPERS Comparison (cont.)

JANUARY 1977	JANUARY 1978
o Support. Memory management based on task priority of AIPERS modules only: No TTDL task management. Dynamic memory (BFRTSK) used only marginally.	o Support. Performed custom system generation to reduce system memory requirements and provide a partition for TTDL task management. Created automatic start-up procedures and AIPERS generation procedures. Installed TTDL release 3 with IBM 3270 software for INCO 3270 equivalent terminals. Initiated use of TTDL library manager facility. Initiated use of Structured Programming techniques via Macros.

Figure 1-2. AIPERS Comparison (cont.)

SECTION 2. RESPONSE TO THE STATEMENT OF WORK

2.1 Background. The SOW for this contract consists of five tasks. The work performed for each of these tasks is detailed in the following paragraphs.

2.2 Subsystem Specifications for the Scenario Generator Subsystem. These specifications have as their basis the Scenario Generator of the DUP, using the overall program flow and data base design. The extended capabilities defined for the Scenario Generator include multi-mission libraries, a generalized message categorization scheme, message routing to multiple arbitrary destinations, multiple extended user/analyst resource classifications, definition of timed system responses for user/analyst queries, more sophisticated response prediction for decision analysis, and threshold criteria definition for automatic conditional message distribution.

2.3 Enhancements to the AIPERS DUP. Using the specifications published under the previous contract, the three prototype programs of the Scenario Generator subsystem were developed. The Library Manager is a batch program which maintains the Scenario Message Library. The program processes a card image data file and enters, deletes, or categorizes messages in the library. Summaries of the library contents can be obtained for review by the system manager.

The Scenario Selection Processor is the first of a two phase procedure to create the data files for the scenario. The generation team member can specify a category of messages which is of interest. This set of messages is then made available for display, editing, and inclusion in the scenario. If the Message Library contains no message pertinent to the scenario, a new message can be entered interactively into the scenario and also placed in the Message Library for subsequent use. Another feature of this program is the capability to modify messages previously added to the scenario. A hard copy of the scenario exercise messages may be requested.

Processing in the Scenario Selection Processor is designed in a structured format with total control of the processing being given to the user. At each stage of processing the user prompted to enter the next function. A valid command may be entered at this point or if the assistance is required, the command "HELP" results in an informational display being issued. To terminate processing at a given level of execution, the command "STOP" is entered.

The Scenario Formatter performs the second phase function in developing the files for the scenario. Resources which the analyst may access are entered. Messages are time tagged and the anticipated response array and query responses are entered. Using procedures similar to those used in the Scenario Selection Processor, the user controls the functions. When prompted for a command, the user may enter a processing command, a request for assistance

("HELP"), or a request for termination ("STOP"). A hard copy of the information used during the scenario may be requested.

In the Exercise subsystem, the software was restructured to make it more flexible and efficient. The memory requirement was reduced by combining the Scenario Processor functions into the Tracker/Publisher and Exercise Control Processor and eliminating the Scenario Processor as a separate module.

Under the restructured exercise system procedure, the Exercise Control Processor (ECP) has two functions. First, the ECP performs the message scheduling based upon the time tag for the message saved in the Message Time List file. For each message the Publisher is called to issue the message. Additionally, the Control Team functions, such as adding or deleting messages or altering time tags, are performed.

The Publisher/Tracker module has several functions under the current DUP. The Publisher displays the message text on every active user/analyst terminal. Then the message log file is updated to reflect the current message displayed. The decision analysis distribution display on the control team terminal is updated. Finally, each event that occurs during an exercise is recorded on the hard copy logging device and the tracking log file to permit post-exercise evaluation.

The Analyst Function Processor required only minor modifications. This processor performs the user/analyst functions including reviewing messages and requesting information from or querying resources. For each user/analyst active during the exercise, a separate copy of this processor is executed.

Overlay structures were created for the Exercise Control Processor, the Analyst Functions Processor, and the On-Line Editor. These overlays resulted in a reduction of memory which aided in resolving memory management conflicts.

The interface with TTDL was upgraded to incorporate SSB Release III TTDL Software. Features in this new release permitted the use of IBM 3270 compatible terminals (RAYTHEON PTS-100).

2.4 Installation of the AIPERS DUP at RADC. This task was modified by an engineering change proposal and a substitute task was performed. The revised task was to research the interface of AIPERS and SSB. The resultant functional description is included as Appendix A of this report.

2.5 Perform AIPERS DUP Demonstrations. During the term of this contract, three formal demonstrations were given, occurring in the months of June and October 1977, and January 1978. The project engineer, Pat Langendorf, was present at all of these sessions.

During these demonstrations the various features of AIPERS were presented. A complete 26 minute, 15 message exercise, supporting two user/analysts in TTDL teletype mode and a control team was run to completion. Additionally an exercise was run demonstrating the capability of multiple user/analysts utilising split screen IBM 3270 compatible terminals. The features of the Scenario Generation subsystem were also demonstrated. These included the message library creation and maintenance, and the message selection and preparation for the exercise.

2.6 Computer Program Delivery. At the termination of this contract, a copy of all software related to AIPERS was delivered to RADC. This included source, object, and task image of the AIPERS modules and the task images of the support software. Additionally, the procedures which were developed to perform assemblies, listings, and task building were delivered. The form of these deliverables consisted of a magnetic tape containing a preserve of a disk pack and hard copy listings of the source image files.

2.7 Deliverables. In accordance with Contract Data Requirements List, there are five deliverables associated with this contract.

A001 - R&D Status Reports. The status reports were submitted to RADC monthly. These reports reflected the contract performance during the period.

A002 - Subsystem Specifications. The specifications for the Scenario Generation Subsystem were presented in the report. These specifications outlined a system which was an outgrowth of the AIPERS DUP Scenario Generation Subsystem.

A003 - Users Manual. This document detailed the user interface during an exercise. The control team functions, the analyst functions, and the on-line editor functions were defined.

A004 - Computer Program Documentation. This document provided maintenance information for the six modules of the AIPERS DUP. Program descriptions, variable definitions, and flow charts were included for each program.

A005 - Technical Report. The accomplishments, status, and potential future goals of the AIPERS project are discussed in this document.

SECTION 3. FUTURE GOALS

3.1 General. The research and development work accomplished in the previous and current AIPERS contracts has established a base for proceeding toward an operational AIPERS/SSB (Standard Software Base) exercise system. SSB is an operational system and work leading toward an extended exercise system could be based primarily upon the extension of AIPERS facilities.

The current AIPERS is displayed in Figure 3-1. The major new capabilities which could be added are an AIPERS enhanced Decision Analysis capability, automated aids to post-exercise evaluation and integration within the SSB environment. The potential areas for development are described in the following sections.

3.2 Decision Analysis Capability. The decision analysis capability would permit comparison of an analyst response to main event messages with a prepositioned response array which has values assigned to each response. Invalid or unique responses would get the immediate attention of the control team. This decision analysis capability would also provide answers to analyst queries directed to agencies not participating in the exercise. These answers would be inserted in the scenario processor and scheduled to arrive in the analyst queue at times comparable to those of actual response conditions.

3.3 Automated Post-Exercise Evaluation Aids. The automated aids to post-exercise evaluation would provide summary data of system actions, decision analysis details and isolated actions related to specific main scenario events. This data would be provided in summary form for the evaluation team. Figure 3-2 portrays the inputs which would lead to the formulation of summary data. The summaries could save many hours of referencing notes and painfully reconstructing the analyst handling of specific events.

3.4 Upgrade AIPERS. The modification of current AIPERS modules (analyst, control team, and publisher) would be directed primarily to the use of AIPERS with the U-1652 terminal. Architecture of the extended AIPERS including the potential capabilities described in Section 3.2 and 3.3 is portrayed in Figure 3-3.

3.5 AIPERS/SSB Analyst Station. The development of the AIPERS/SSB Analyst Station would consist of the adaptation of AIPERS to the SSB environment. Figure 3-4 shows an overview of the system. The functional description for the system is contained in Appendix A of this report.

3.6 System Documentation. Documentation essential to an exercise planner and to the AIPERS/SSB is envisioned. The exercise Planner's Guide would be designed as a comprehensive manual adaptable for all intelligence exercise planning. It would assist in:

- Establishing exercise goals
- Scenario development

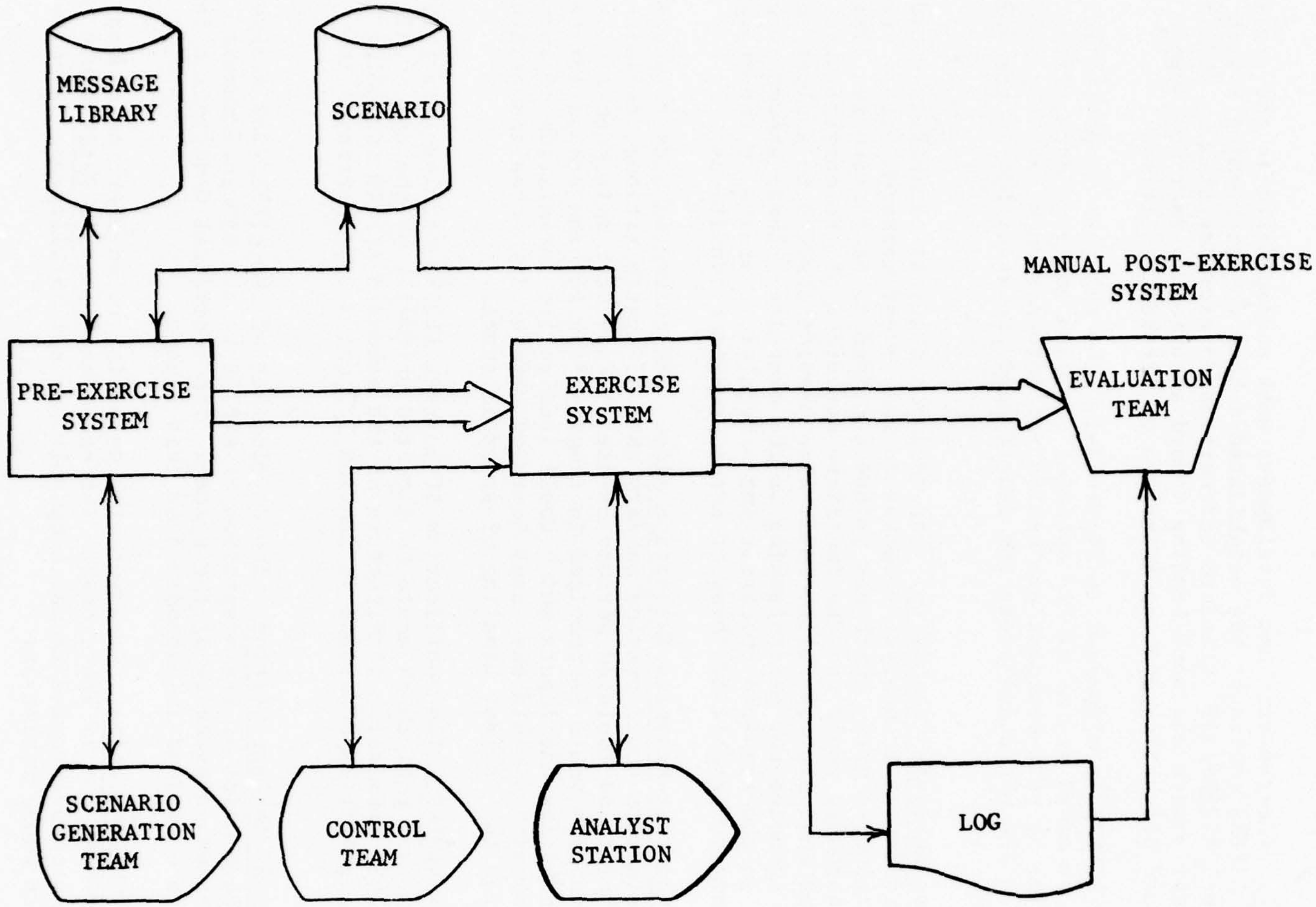


Figure 3-1. Current AIPERS System Summary

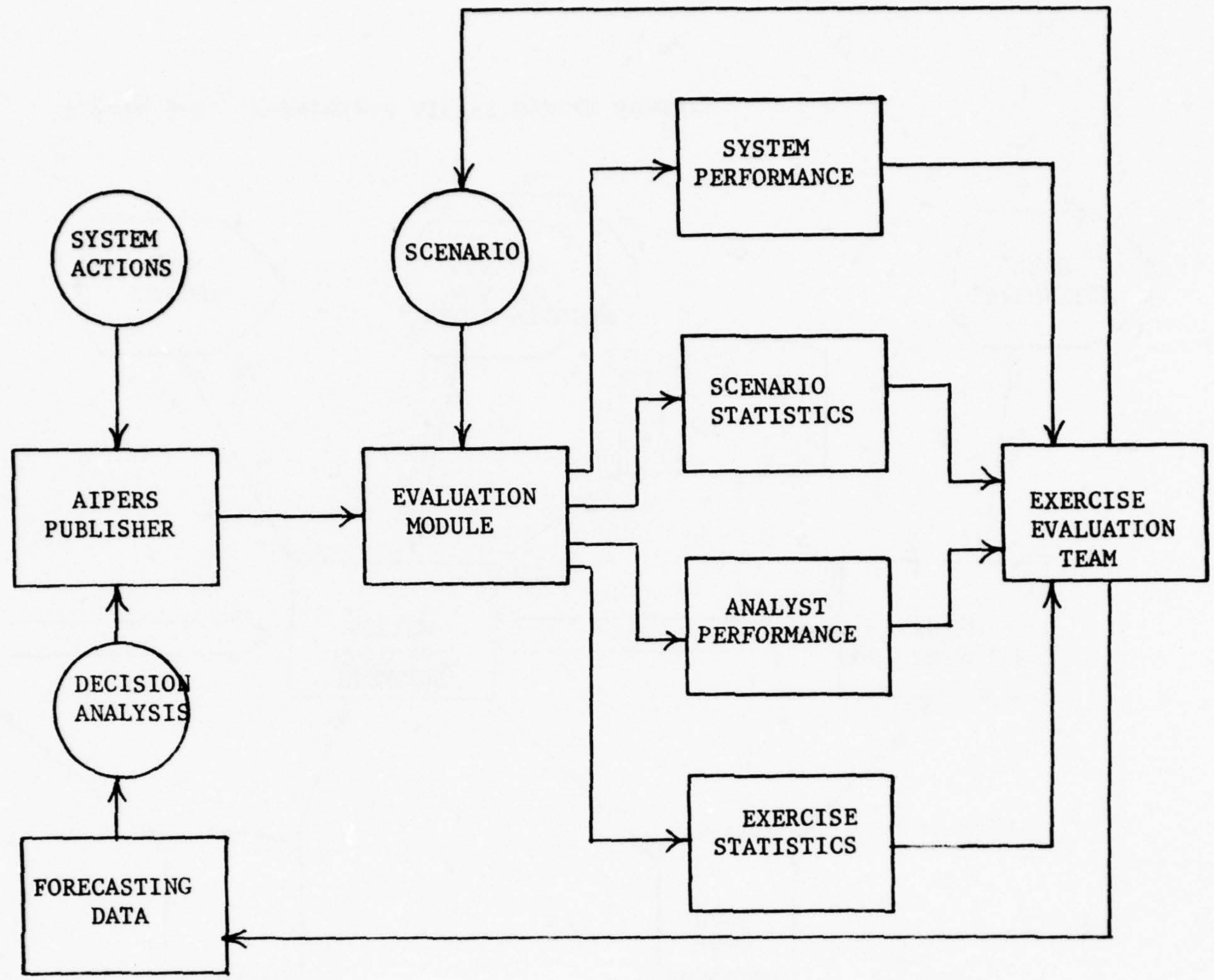


Figure 3-2. Post-Exercise Evaluation

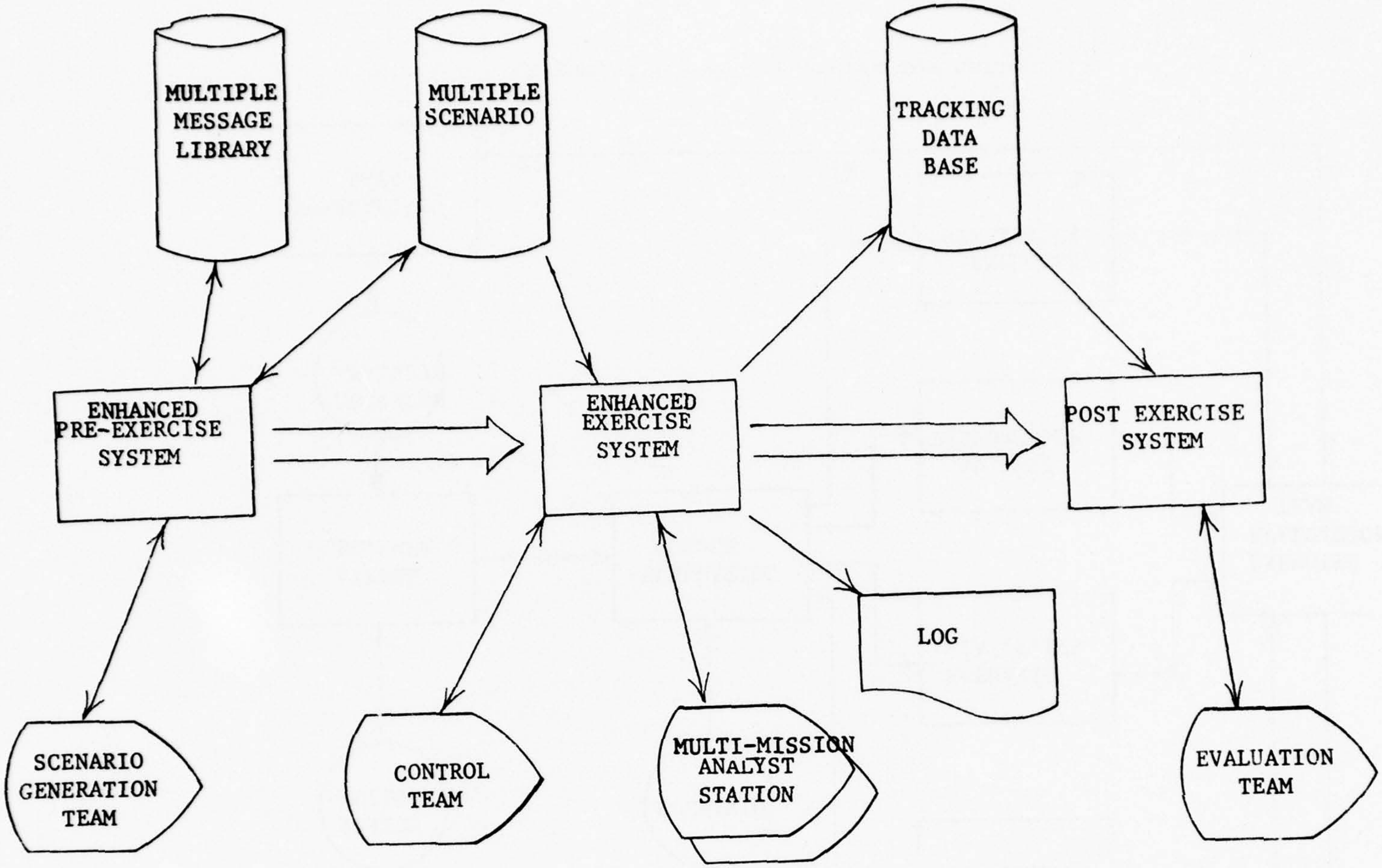


Figure 3-3. Modernized AIPERS System Summary

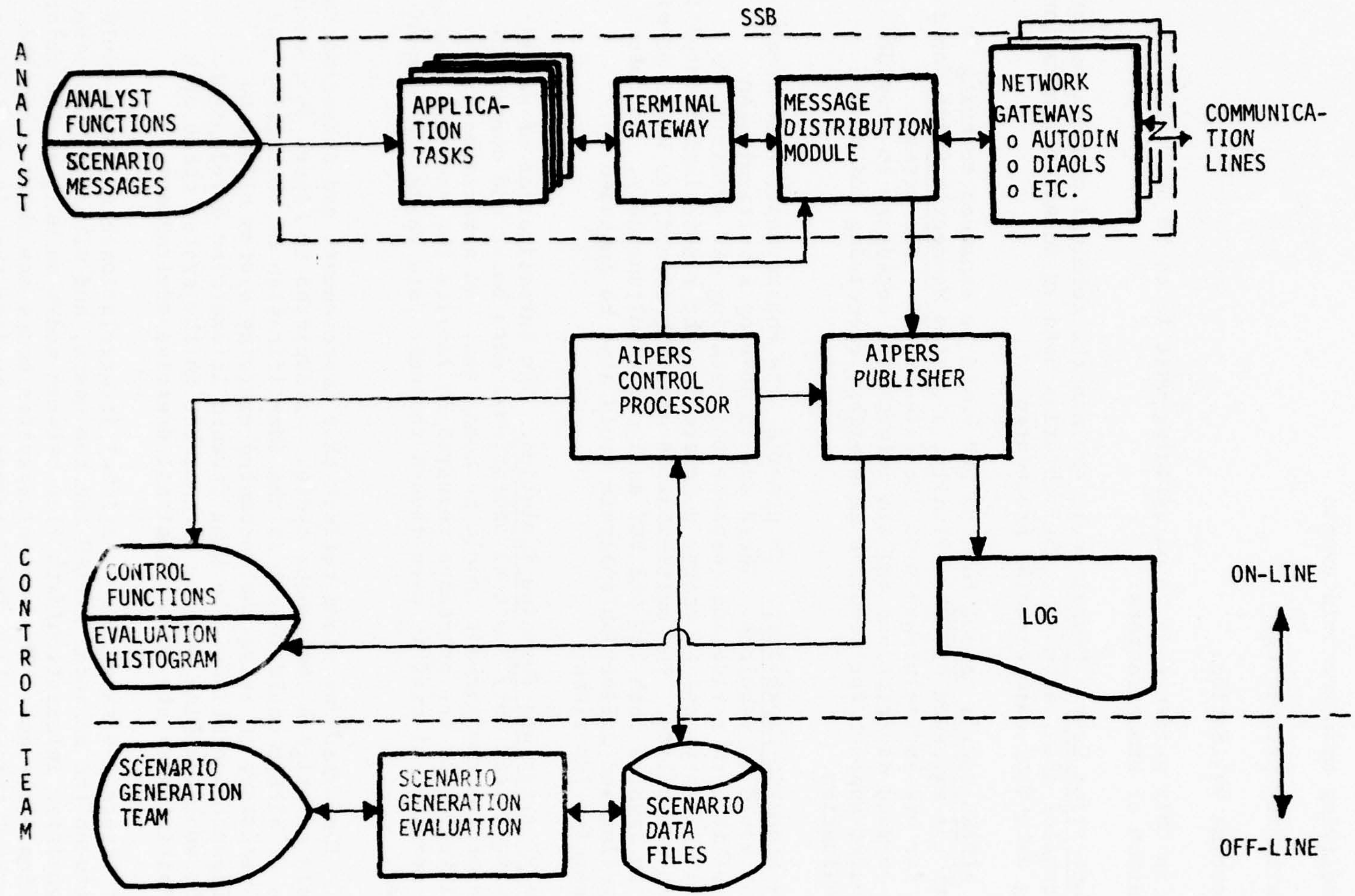


Figure 3-4. AIPERS/SSB System Overview

- o Specifying main scenario events
- o Evaluation methodology
- o Exercise validation.

The emphasis in this guide would be on defining what is to be evaluated and the consideration of human factors.

A Scenario Generation User's Manual would explain the terminal procedures for using the automated aids, accessing the libraries used in scenario generation, and examining data from past exercise procedures.

The existing AIPERS User's Manual for the DUP would be enhanced to bring it into line with the extended AIPERS. Finally, a System Manager's Guide would be developed for use and maintenance of the data system - the message library, the command descriptions and all information necessary to provide exercise computer support for scenario generation, exercising and post-exercising evaluation.

3.7 Multiple Scenario Capability. To provide this enhancement, four areas of development would be required. These are to develop a multi-mission scenario capability, to revise and complete the existing I&W scenario, to initiate an S&T Library, and to create software for the multi-mission intelligence scenario capability. The multi-mission scenario capability would permit the exercise to involve both I&W and S&T analysts simultaneously. On future efforts, targeting and collection analysis could also be included as legitimate exercise functions.

3.8 "Read Only" Areas and Exercise Isolation. The investigation of security aspects of using ("read only") actual operational data bases and communications in an exercise environment should be conducted. An associated area would be to investigate the processes required to isolate the exercise message traffic from operational traffic even though the same data bases and communications are used.

3.9 Summary. The areas described reflect that improvements and enhancements to AIPERS would comprise a continuous cycle. As depicted in Figure 3-5, each demonstration of AIPERS could result in the identification of shortfalls and improvements necessary to bring the automated exercise system closer to actual intelligence operations. Looking forward in exercise development, this technique would combine a major advancement in the system cycle with significant initiatives into the operational exercise environment.

The matrix of Figure 3-6 shows the functional interrelationships which would take place between the enhanced AIPERS and the users, and within AIPERS itself. The chart identifies information/data flow between nodes as well as the major system/subsystem exchanges. The system/subsystem nodes are shown along the diagonal (blocks 1 through 11). The information or data that is provided or

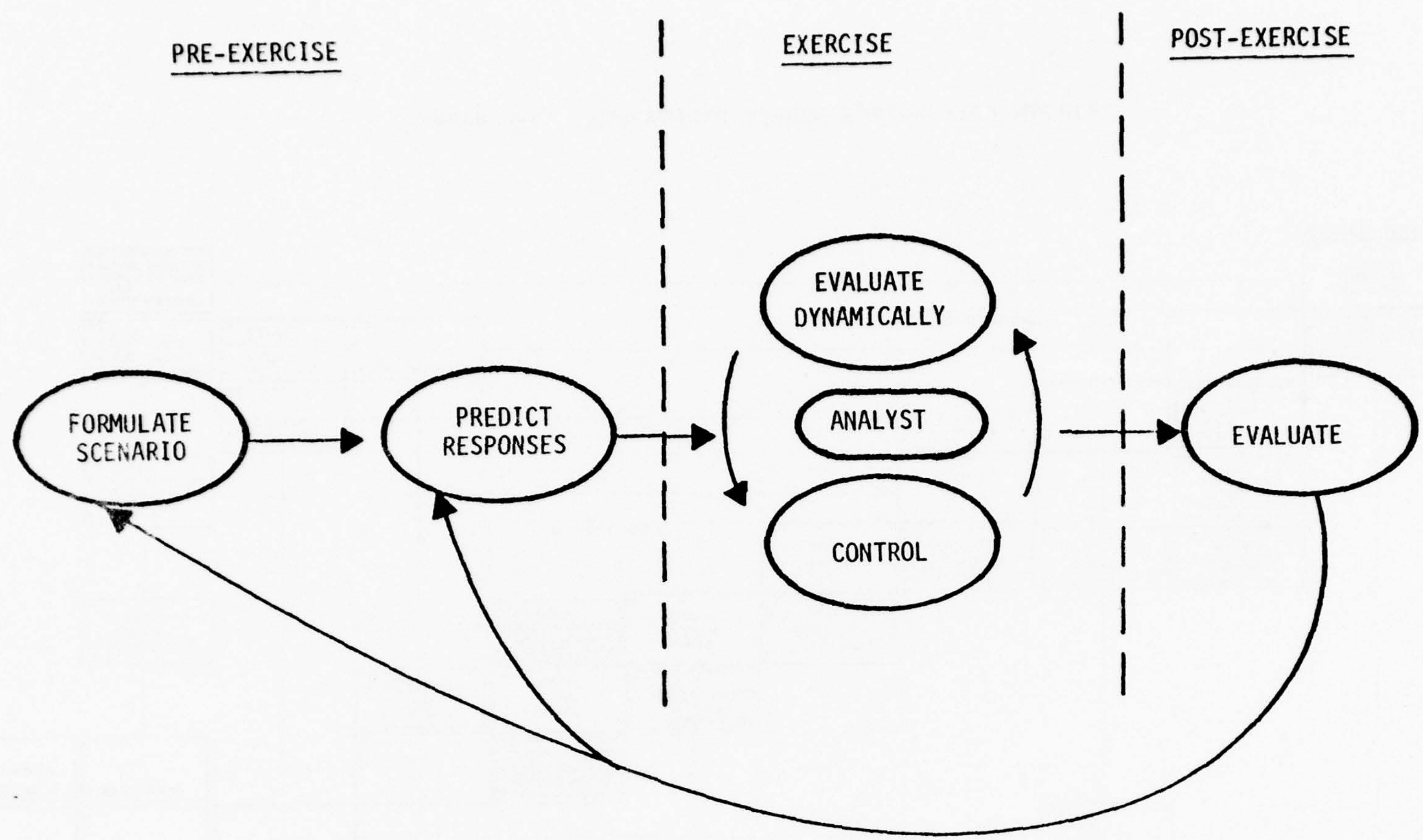


Figure 3-5. AIPERS Improvement Cycle

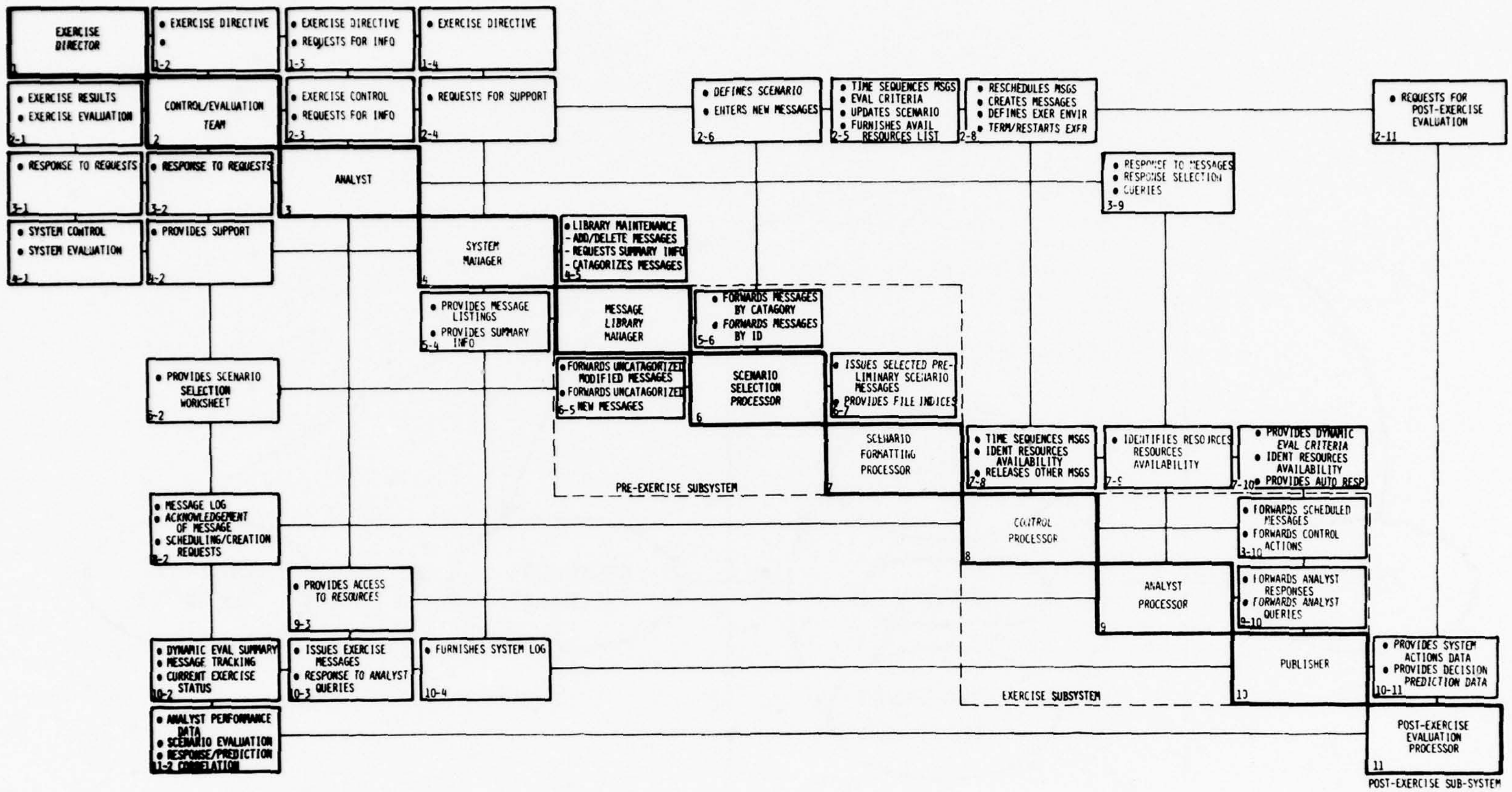


Figure 3-6. Modernized AIPERS System/Flow Matrix

received are shown along the horizontal or vertical axes. A block along the horizontal is an output from a node; a block along the vertical is an input. For example, the block labeled 1-3 shows that the Exercise Director issues an exercise directive to the Control Team and, in turn, the Control Team closes the informational loop by providing reports to the Exercise Director. The chart identifies the tasks that are performed but not how they are accomplished. Some of the data flow is still accomplished manually based on generated data which is manipulated by the user and then reentered either back to the sending module or to another based on the type of information/ data.

SECTION 4. SYSTEM/SOFTWARE DESIGN

4.1 Overview. General improvements and additions to the AIPERS Exercise Subsystem were made during the current contract. The improvements were in the form of modifications to existing modules as well as architectural changes. The basis for the improvements was providing greater stability and optimizing performance. The main addition to the exercise subsystem was the decision analysis capability. A summary of improvements is given below:

- Modified necessary modules to use RSX-11D overlay capability.
- Installed SSB release III TTDL and performed custom system generation to reduce memory requirements and limit memory fragmentation.
- Enhanced control processor to include message scheduling thereby avoiding access/update contention problems.
- Enhanced tracker (Publisher) to perform message publication as well as decision analysis.
- Modified AIPERS text editor to improve operating efficiency.

4.2 Overlay Construction. Overlay segments have been constructed from the Analysts Functions Processor (AFP) and the Exercise Control Processor (ECP). The basic approach has been to construct three levels of segments from each main program and two for the co-tree, i.e., EDITOR. These levels contain the following information (see also Figure 4-1).

Main Tree

Level Ø Single Segment

Control module, file info, EDITOR data, error routines and displays, ICM subroutines, and other subroutines required for both initialization and processing.

Level 1 Two Segments

Initialization module, select menu display, processing and termination modules, and function subroutines.

Level 2 Multiple Segments

Functions modules, and function displays.

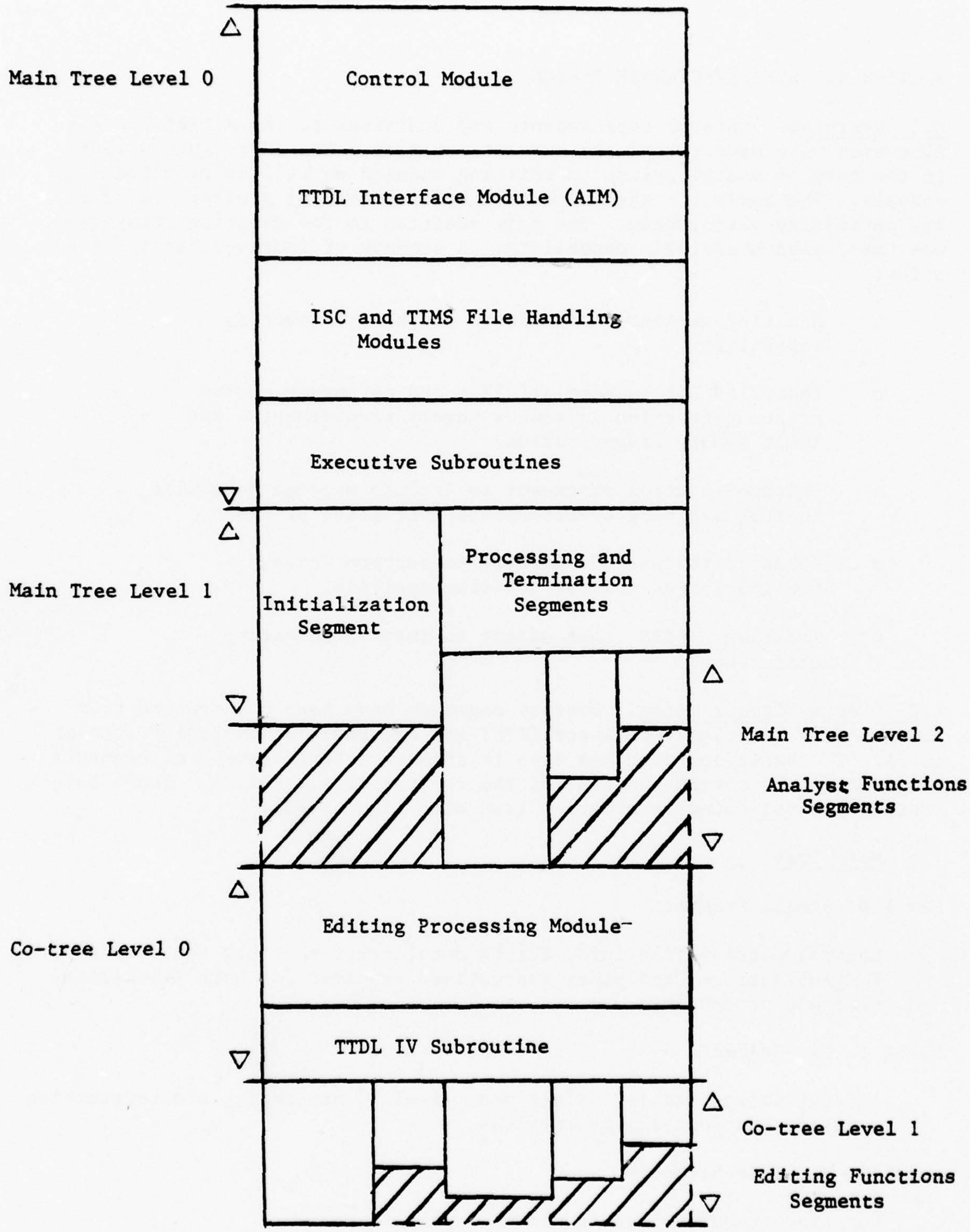


Figure 4-1. Memory Diagram

Co-Tree

Level Ø Single Segment

Editing text buffers, EDITOR processing module, error handling, and editing subroutines.

Level 1 Multiple Segments

EDITOR functions modules and function displays.

The DEC task builder manual contains a discussion of multiple tree structures. A co-tree is used because several lower level segments of the main tree reference a module which is itself segmented, i.e., EDITOR. The root segment of the co-tree will remain resident, once loaded. This approach reduces disk storage requirements and load time as well as permitting a simpler overlay description.

At task build all external modules with the exception of the TTDL IV subroutines, are appended to the root segment of the main tree. This linkage occurs because the major software products are single user, e.g., TIMS, or are referenced through ICM via an interface module, e.g., TTDL AIM. In the case of single user modules, a single reference appends the entire module, and all subsequent references in further levels are directed to the single occurrence modules and, consequently, ISC file handling modules are appended. A similar situation occurs with TTDL. However, the concatenated module embodies only entry points.

The purpose of overlay construction is, of course, memory space reduction. Level 1 was used to overlay initialization code which, by definition, is needed only at task startup. The tasks have been further partitioned on the basis of operator selected functions, since the programs were written with functions as the fundamental modular unit. No attempt was made to further reduce space by selective subroutine segment loading. There are some possibilities for such reductions, e.g., PSECT SGDTG. All support subroutines are maintained in Level 1 in the main tree and Level Ø in the co-tree.

Overlays were constructed using program sections, i.e., PSECT, instead of object modules for several reasons. PSECT structuring permits a single consolidated source listing and is easier to examine, correct, and assemble. One disadvantage, not readily apparent, is that program sections are not autoloadable. Consequently, all loading was performed manually, i.e., via calls to $LOAD. Some modifications, in addition to program section placement, were required to assure that functions were not referencing code in parallel functions.

As a result of segmentation and a reduction in file buffers, the analyst processor was reduced in size from 65,000 to 56,000 octal. A substantial reduction in the control processor was, also, obtained. There is no performance degradation because of the already slow nature of menu selection.

4.3 AIPERS Memory Requirements. Because of the continuing memory space problems with AIPERS, a thorough memory requirements analysis was performed resulting in a revised system generation phase I file and modifications to the exercise initialization system.

The following modifications were made to the Standard RSX-11D Sysgen Phase I file.

1. Creation of separate 16K TTDL partition for transient TTDL tasks.

   Sysgen Statement: PAR = TTDL,,1000,S

2. Reduction of System Node Pool.

   Sysgen Statement: SCOM = ,400,100

3. Installation of the overlay version of the disk auxiliary control processor.

   Sysgen Statement: INS = GEN,[11,1]FCP

The TTDL partition is used for all transient TTDL tasks. The terminal tasks, TTDL6T and TTDL6I, and TTDL Common Area, TTDLRE, are still run in the GEN partition, since these tasks are resident throughout the exercise. The use of this partition avoids GEN partition fragmentation without allocating the 30K memory required to fix all the TTDL transient tasks. TTDL is not reentrant and all tasks are serially invoked via the applications interface module (AIM). The worst case TTDL memory requirements can be computed by summing the sizes of the four largest TTDL tasks, since there are four AIPERS tasks, in dual analyst configuration, and, consequently, four interface modules. In practice, it seems that no more than three TTDL tasks are simultaneously resident. For this reason the size of the partition was determined by summing only the sizes of the three largest TTDL tasks.

Another advantage of the TTDL partition is that the TTDL generation task, TTDLGEN, and the command processor, AT., may be run in the TTDL partition to avoid fragmentation in the GEN partition. This task is only resident at system initialization, but invokes the TTDL terminal task and, consequently, the common areas, all of which are resident throughout the exercise.

The system node pool was reduced to an average exercise level of 100 nodes to reduce the size of the executive.

The use of the overlay version of the F11ACP task resulted in savings of approximately 3K words, at the cost of slower disk access. It should be noted that the auxiliary control processor was fixed in memory immediately after phase II of Sysgen, and prior to loading any handlers. Since all unnecessary handlers are removed by the exercise initialization procedure and the disk processor must remain throughout the exercise, fixing the auxiliary disk processor avoids fragmentation problems.

One modification was made in the intertask communication module, ICM, to reduce the number of internal nodes from 128. to 64,, resulting in a 1K savings. The node pool size is determined by a conditional assembly variable, TPNDN, and is based on maximum simultaneous services requests and dynamic allocations.

The resulting memory requirements for each system and support software component are described in Figure 4-2. Almost 84K of the 124K memory is used leaving approximately 40K for AIPERS tasks. Figure 4-2 details the memory requirements for AIPERS on a task basis.

As AIPERS expands there are several methods by which memory requirements can be decreased. Task size can be reduced by overlay techniques and use of the TTDL display library. Task management can be effectively handled via checkpointing.

4.4 Exercise Subsystem Design. Some problems were alleviated by a modified design. The problems were excessive memory requirements and occasional timing problems, resulting in incorrect scenario message publication.

More specifically, there were contention discrepancies in the access and updating of the message time list file, which drives the scenario. To take advantage of the scheduling capability of RSX, the scenario processor schedules the "next" message immediately after the current one is published, i.e., the scenario publishing is event driven rather than discrete time interval driven. In the case where the control processor is requested to modify the "next" message either by actually changing the time, or adding an immediate message or deleting the "next" message, there is extensive programming required to provide the necessary communication to assure that the next message is indeed the one that the control team requested. This processing is much easier to handle if the communication is not task-to-task, but within a single task. So, it was appropriate to incorporate the Scenario Scheduling function into the exercise control processor.

Some other concerns are the following. Although the scenario processor is event driven, an internal one second "clock" was maintained by using RSX clock services. This clock was actually used to publish messages. Since very often the scenario processor may be checkpointed to disk, this clock loses about one second per minute. If instead the RSX task scheduling services are used, the time loss and checkpointing overhead could be reduced.

BASIC SYSTEM

Component	Decimal Size (words)
RSX11D	16.1K
SYSRES	4.1K
Disk Handler	1.0K
F11ACP (overlayed version)	3.0K
Teletype Handler	2.8K
MCR Partition	1.3K
	27.2K

SUPPORT SOFTWARE

Component	Decimal Size (words)
ICM-Intertask Communication Module	4.3K
BFRTSK - Buffer Task	16.0K
TTDLRE - Common Area	12.0K
TTDL6T - Teletype Terminal Task	4.1K
TTDL6I - IBM 3270 Terminal Task	2.5K
TTDL Partition	16.0K
IBM 3270 Handler	4.0K
	56.9K

AIPERS

Component	Decimal Size (words)
Analyst processor (multiple)	11.5K
Control processor	13.2K
Publisher	11.2K
	35.9K

Figure 4-2. System Memory Requirements

The only other function of the scenario processor is message publishing. It was reasonable to incorporate this function into another task to reduce system overhead, e.g., redundant file access routines. The logical choice would seem to be the exercise control processor. However, since it constantly maintains a function menu, TTDL would need to be reentrant and it is not. A similar situation exists with the analyst processor. The tracker, however, publishes via asynchronous flashes and can queue and publish the scenario messages without difficulty.

In summary, the following design enhancements were incorporated into AIPERS:

1. Incorporate scenario scheduling into the control processor.

2. Include scenario publishing into the Tracker (Publisher).

4.5 Text Editor Improvements. In addition to overlaying the text editor to reduce the size of all tasks which use the editor, two other improvements were made. First, key data movement and search routines, e.g., SECMOV, were optimized to increase the speed of editing. Second, the control menu was made optional as in the scenario generation software. So, unless the user requests menu operation, he can use abbreviations following the command request prompt.

4.6 Decision Analysis. Decision analysis information consists of two Response Distributions for each of up to three analysts. One distribution contains a cumulative exercise distribution; the other a floating five (5) message average. Rather than actual counts, the distribution is listed in percentiles. In addition, the screen area contains the real and simulated times and a recent events list containing the last ten (10) actions (control, or any user/analyst) with the associated simulated time. All of this information is maintained on an alternate control team screen area by the publisher module. Other additions to the publisher include publishing the response arrays, and maintaining a sequential system action file on disk.

Two sources could be used to determine to which message a response is attributable. The "acknowledge message" user analyst function is not used, since all analyst functions request prompting message ID. The actual time sequence is not used since the user analyst may not have viewed the incoming message immediately on arrival in teletype terminal operation.

The system action file contains identically the contents of the service request blocks passed to the publisher module as well as the elapsed time. Decision analysis data is thus contained implicitly rather than explicitly. The contents of each service request block is listed in AIPERS Interim Program Documentation (1976).

SECTION 5. SCENARIO GENERATION SUBSYSTEM

5.1 Background. This subsystem was developed during this contract period to provide automated assists in the creation of exercise scenarios. To facilitate this capability, a message library is maintained to provide a source of message categorized by content. The scenario generation team may select messages from the library either explicitly or by category and modify the message as desired prior to inclusion in the exercise scenario.

Prior to using the Scenario Generation Subsystem, a preliminary manual procedure must be performed. The goal of the exercise scenario is chosen, and then the appropriate message topics are specified so that the message library may be scanned for appropriate messages.

5.2 User Interface. The subsystem consists of three modules communicating through data files. The structure of the subsystem is illustrated in Figure 5-1. The generation team inputs requests via data file or CRT as indicated.

5.2.1 Library Manager. The Library Manager module serves two functions. First, maintenance of the Scenario Message Library is performed. Messages can be added, deleted, or reclassified as needed. The second function is to produce hard copy listings of the library contents to enable manual review by the generation team so that appropriate messages can be selected (in the Scenario Selection Processor) or if no messages are available, a new message can be added to the library.

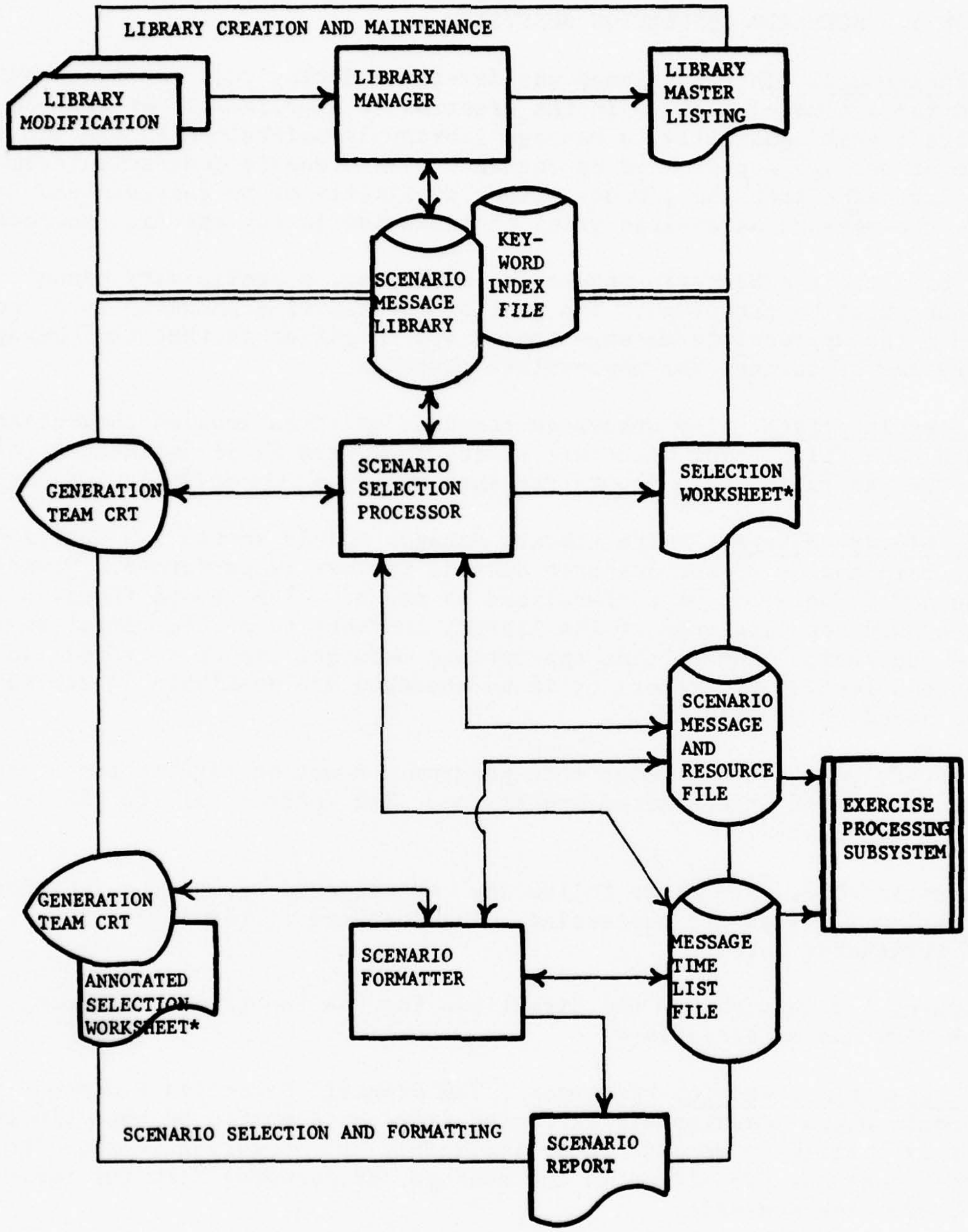
The Library Manager is a batch mode program. A set of five control cards is used to specify the desired processing. The control card format is shown in Figure 5-2.

Where applicable, directives follow the control card to specify additional information required for processing. The function is terminated by a /END/ terminator card.

In Figures 5-3 through 5-6 the directives for the functions are shown. Note that REVIEW has no directives.

5.2.2 Scenario Selection Processor. The Scenario Selection Processor is the module where messages are extracted from the Scenario Message Library either explicitly by message ID or implicitly by category keyword. The selected messages are placed in the Message and Resource File for inclusion in the exercise scenario.

The program is designed so that the user is prompted for input at nested levels. At each level, the user can obtain a display of valid input commands by entering the command "HELP". The command "STOP" terminates processing at the current level and brings the user to the next higher level.



*Note: The selection worksheet is output from the Scenario Selection Processor. Manual annotations are made and the worksheet is used as an aid during the Scenario Formatter processing.

Figure 5-1. Scenario Generator Subsystem

Card Columns	Field Contents	Function to be Performed
1-6	ADDMSG	Add messages to the library
1-6	REFILE	Refile messages under different categories
1-6	DELETE	Delete messages from the library
1-6	REVIEW	Review messages filed under category "IV-a-Ø1" of KWINDX
1-6	SUMARY	Prepare a summary of current message library contents

Figure 5-2. LIBMGR Control Card Format

Message Card No.	Field Column Numbers	Field Contents
1	1-72	FM designator
2	1-60	RE designator
3	1-60	REF designator
	61-74	DTG designator
4	1-5	"/EOH/" (End of Header
5	1-80	Message text line as it will appear on the screen)
. . .		Note: Each new part must be indented five spaces. Maximum of 20 cards per part. Maximum message text length is approximately 4000 char.
M	1-5	"/EOM/" (End of message)
M+1	1-3	Roman Numeral Category
	5	Alphabetic subcategory
	7-8	Numeric subcateogry
. . .		Note: Maximum of 10 category cards.
N	1-5	"/EOC/" (End of Categories)

Figure 5-3. ADDMSG Input Format for Scenario Library Messages

CARD COLUMNS	OONTENTS	PURPOSE
1-3 5-14 15-18 20 22-23	ADD Message ID "To" Category Numeral Alphabetic Subcategory Numeric Subcategory	Add a message reference to the specified category.
1-3 5-14 16-18 20 22-23	DEL Message ID "From" Category Numeral Alphabetic Subcategory Numeric Subcategory	Delete a message reference from the specified category.
1-3 5-14 16-18 20 22-23 25-27 29 31-32	MOV Message ID "From" Category Numeral Alphabetic Subcategory Numeric Subcategory "To" Category Numeral Alphabetic Subcategory Numeric Subcategory	Move a message reference from one category to another.

Figure 5-4. REFILE Function Input Card Format

CARD COLUMN	CONTENTS	PURPOSE
1-10	Message ID	Delete a Message from the Message Library

Figure 5-5. DELETE Function Input Card Format

CARD COLUMNS	CONTENTS	PURPOSE
1-6	KWINDX	File specification
8-12	COUNT or MSGID	List count of ID's or individual message ID's
14-16	First Category Numeral	Optional first category to be reported. (If blank, list starts with category I-a-01)
18	Alphabetic Subcategory	
20-21	Numeric Subcategory	
23-25	Last Category Numeral	Optional last category to be reported. (If blank, list stops with category IV-a-01.)
27	Alphabetic Subcategory	
29-30	Numeric Subcategory	
1-6	MSGLIB	File specification
8-10	RE or MSG	List RE header line or entire message
12-14	CAT	List categories which reference message (optional)
16-25	First Message ID	Optional first message to be reported. (Default=AES-ØØØØØ1.)
27-36	Last Message ID	Optional last message to be reported. (Default=AES=999999.)

Figure 5-6. SUMMARY Function Input Card Format.

Initially, the user specifies the name of the Scenario Message Library and Message and Resource File. The prompt is:

MSGLIB = MSG & RES =
(NEW/OLD) =

Permitting this specification allows the processing of multiple libraries. The NEW/OLD specification permits the start of a new exercise data file (NEW) or the continuation of building onto an existing exercise data file (OLD).

The next prompt begins the prompt message which is repetitive. This is the highest level prompt and if "STOP" is entered, the program is terminated.

INPUT SOURCE =

The acceptable responses are

1. SCNMSG - Scenario Message Library
2. MSGRES - Message and Resource File
3. NEW - Interactive via Terminal
4. HELP - List This Menu
5. STOP - Terminate This Program
6. LIST n,k - List the Scenario (message ID's n thru k)

For each of these commands, an appropriate prompt sequence is performed. Each sequence is described in the following paragraphs.

1. SCNMSG - To access the Scenario Message Library (MSGLIB), the user is prompted to specify the three levels of keys used to categorize messages. The prompt is:

KEY n = where n=1,2,3.

The acceptable responses:

- o The actual key for the level
- o "MSGID" whereby the input of keys is terminated and the prompting for the message ID (6 digits) for specific messages is begun.
- o "STOP" whereby Message Library processing is terminated.
- o "NEXT" prompt for key 1 of next message set.

If all three keys are input to specify a category, a display of all messages in the category set is output. The user is then asked to select the message to be processed. The prompt is:

MSGID =

The acceptable responses are:

- o The actual 6 digit key
- o "NEXT" references next message in the list. (It should be noted that if the user reached this point by entering "MSGID" to a prompt for a key, there will be no "NEXT" message. Each message reference must be by 6 digit key.)
- o "HELP" whereby all message ID numbers in the category are displayed. The valid commands are also displayed.
- o "STOP" whereby processing messages in the category is terminated and the first key of the next category is solicited.

As each message is selected and retrieved, the user can edit, review, and add messages to the MSGRES. The prompt is:

FUNCTION =

The acceptable responses are:

- o REVIEW - Review Message Text
- o EDIT - Edit the Message
- o ADD - Add Message to MSGRES
- o HELP - List this Menu
- o STOP - Terminate Processing This Message

REVIEW results in the message being displayed at the terminal.

EDIT places the user in edit mode where modifications can be made to the text prior to adding to the message library.

ADD results in the current message (with modifications) being added to the Message and Resource file. The message ID is generated. The user is then asked if the message is to be added to the scenario message library in the "NO CATEGORY" classification. The prompt message is:

SAVE IN SCENARIO MESSAGE LIBRARY (YES OR NO)?

HELP results in the command menu being displayed.

STOP terminates processing this message. The prompt for the input of the next message ID is displayed.

2. MSGRES - When accessing the Message and Resource File (MSGRES) the 6-digit message ID number is used as the key. The prompt is:

MSGID =

where the user inputs the 6-digit key. (This value was assigned when placing in the MSGRES file and it may not be the same as the number assigned to the message in the MSGLIB Library.)

Optionally, the user may enter "NEXT" and the next message is accessed. (Access is in the order that messages were placed in the MSGRES file.) "STOP" terminates input from MSGRES. As each message is selected, the user can perform editing and review functions. The prompt is:

FUNCTION =

The acceptable responses are:

- REVIEW - Review Message Text
- EDIT - Edit the Message
- REPLACE- Replace Message
- DELETE - Delete Message
- HELP - List this Menu
- STOP - Terminate Processing this Message

REVIEW results in the message being displayed at the terminal.

EDIT places the user in the edit mode.

REPLACE results in the message being processed replacing the text in the library under the same message ID number. If any editing was performed, the user is asked if the message is to be saved in MSGLIB in the "NO CLASSIFICATION" classification. The prompt is:

SAVE IN SCENARIO MESSAGE LIBRARY (YES OR NO)?

DELETE removes the message from the MSGRES file.

HELP lists the menu of available commands.

STOP terminates processing this message.

3. NEW - New messages can be entered interactively through the terminal. (Note that library maintenance functions on the Scenario Message Library can be performed using the library manager module.)

The user is prompted with a request for a command.

FUNCTION =

The acceptable responses are:

- o EDIT - Create/Edit Message Text
- o ADD - Add Message to Library
- o HELP - List this Menu
- o STOP - Terminate Processing New Messages

EDIT provides all of the capabilities to create and edit a message.

ADD results in the message being added to MSGRES. After adding the message to MSGRES the user is asked if the message is to be added to MSGLIB. The prompt is:

SAVE IN SCENARIO MESSAGE LIBRARY (YES OR NO)?

HELP results in the command selection menu being displayed.

STOP terminates processing new messages.

4. HELP displays the available commands

5. STOP terminates the program.

6. LIST produces a hard copy listing of the Message and Resource File. If start and stop message ID numbers are specified (n,k) all messages in the file that were created after n and before k, as well as message n and k, will be listed.

5.2.3 Scenario Formatter. This processor is used to add additional information into the Message Resource File for use during the exercise. These items include the eight variable resources, message time tags, and message anticipated response arrays. Additionally, messages entered into the Message and Resource File may be reviewed or modified.

The prompt sequence and user responses are as follows:

DEFINE RESOURCES (RES) OR TIME TAGS AND RESPONSE ARRAY (TAGS):

1. RES - In this mode the generation team member defines resources for the scenario. The prompt is:

NAME = name TYPE = t MENU # = mm

NAME - A 1-13 character resource name or "STOP" to indicate end of resource definition or "HELP" to request a display of the current resources.

TYPE - The resource type. The valid values are:

Q - Query the data base

A - Access a source reference (such as a map)

R - Request information from other personnel or agency

MENU # - An integer whose value is 5-12 corresponding to the menu numbers in the analyst function menu.

2. TAGS - In this mode, the information required on a per message basis is entered (e.g., time tags and response arrays).

The prompt input defines the message ID

ENTER MESSAGE ID OR "STOP" AES - XXXXXX

where XXXXXX is the message ID number or "STOP" to specify the BLDMRS is to be terminated.

The user next has a choice from a seven function selection menu. This menu is displayed only in response to the "HELP" function. The prompt for an input function is:

FUNCTION: To which one of the following may be input:

REVIEW, EDIT, TAG, PREDICT, NEXT, HELP, STOP.

These keywords refer to the possible actions which are:

- REVIEW - REVIEW MESSAGE CONTENTS
- EDIT - EDIT MESSAGE CONTENTS
- TAG - ASSIGN TIME TAG
- PREDICT - ANTICIPATED RESPONSE ARRAY
- NEXT - NEXT MESSAGE
- HELP - LIST THIS MENU
- STOP - TERMINATE PROGRAM

The function performed by each command is described below:

- o REVIEW and EDIT branch to the EDITOR to perform the function desired.

- o TAG results in the prompt for the time tag.

ENTER TIME TAG - ELAPSED TIME FROM EXERCISE START (HH:MM:SS)

- o PREDICT is the command for entering the anticipated response array. The user is prompted with:

  ENTER: to specify the function desired. These functions are:
  LIST nn - display response nn (5<=r<=12)
  nn $\pm$ m - assign a value of $\pm$ to response nn
  (-6<=m<=+6).

  STOP - terminate BLDMRS
  HELP - display all possible responses.

- o NEXT results in the program returning the ENTER MESSAGE ID AES - prompt described above.

- o HELP results in the selection menu described above being displayed.

- o STOP causes BLDMRS to terminate. Just prior to BLDMRS termination, the last prompt is issued. DO YOU WANT HARD COPY OF SCENARIO (YES OR NO): If "YES", a copy is printed on a hard copy device.

5.3 Data Files. There are four data files used in the Scenario Generation Subsystem. These files provide the communication between the subsystem modules as shown in Figure 5-1.

5.3.1 Scenario Message Library. This library contains categorized messages which can be treated as the source of messages used in an exercise. The classification is such that all messages belonging to a category, (e.g., LAND-ECONOMIC-TRADE), may be accessed by keyword (e.g., I-A-01) in the Scenario Selection Processor. As new messages are developed to meet the requirements of an exercise, these messages can be categorized and stored for use in later scenario generations. As mentioned earlier, messages are entered into this library using the Library Manager program.

5.3.2 Keyword Index File. The Keyword Index File contains the pointers to the individual messages in the Scenario Message category. These pointers are created and maintained by the Library Manager program as the Scenario Message Library is being updated.

5.3.3 Message and Resource File. Messages are entered into this file using the Scenario Selection Processor. The message text is obtained either from the Scenario Message Library or interactively during a selection session.

Additional items required for the exercise are entered into this file via the Scenario Formatter program. These items include the eight resources which are used throughout the exercise and the response array and replies for queryable resources unique to each message.

5.3.4 Message Time List File. This file is created along with the Message and Resource File. For each message in the Message and Resource File, a corresponding record exists in the Message Time List File. This record contains the time (elapsed seconds since exercise start) at which the message is to be published. Status about the message (e.g., if it was sent, if it was altered by the control team) is also maintained in the record corresponding to the Message and Resource File record.

5.4 Operational Considerations. The three modules of the subsystem may be run repeatedly in a semi-random order. Figure 5-7 schematically shows an example of how the subsystem may be used. Effectively after each program is executed, the option is either to terminate the subsystem processing, re-run the same program, or run a previous program. The final termination of the subsystem would occur when the Message and Resource File has all of the information required to execute an exercise.

To assist the generation team in determining the source of scenario messages, audit trail information is maintained. When the Selection Worksheet is printed in the Scenario Selection Processor, the source of the messages is printed in addition to the message text. The message source is either the message ID from the Message Library or "NEW" indicating that the message was entered interactively during a selection session.

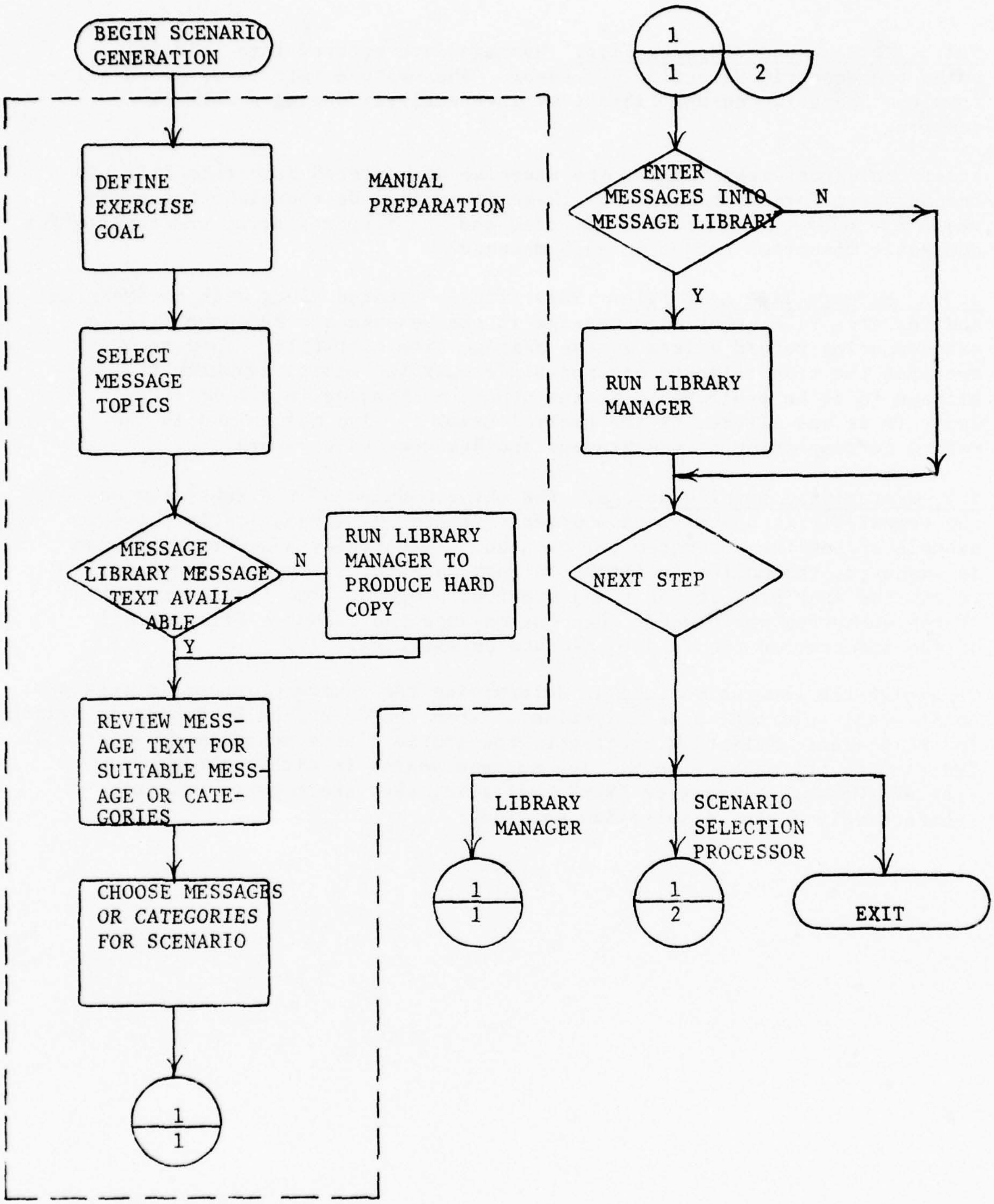


Figure 5-7. Scenario Generation Subsystem Flow

Page 1 of 2

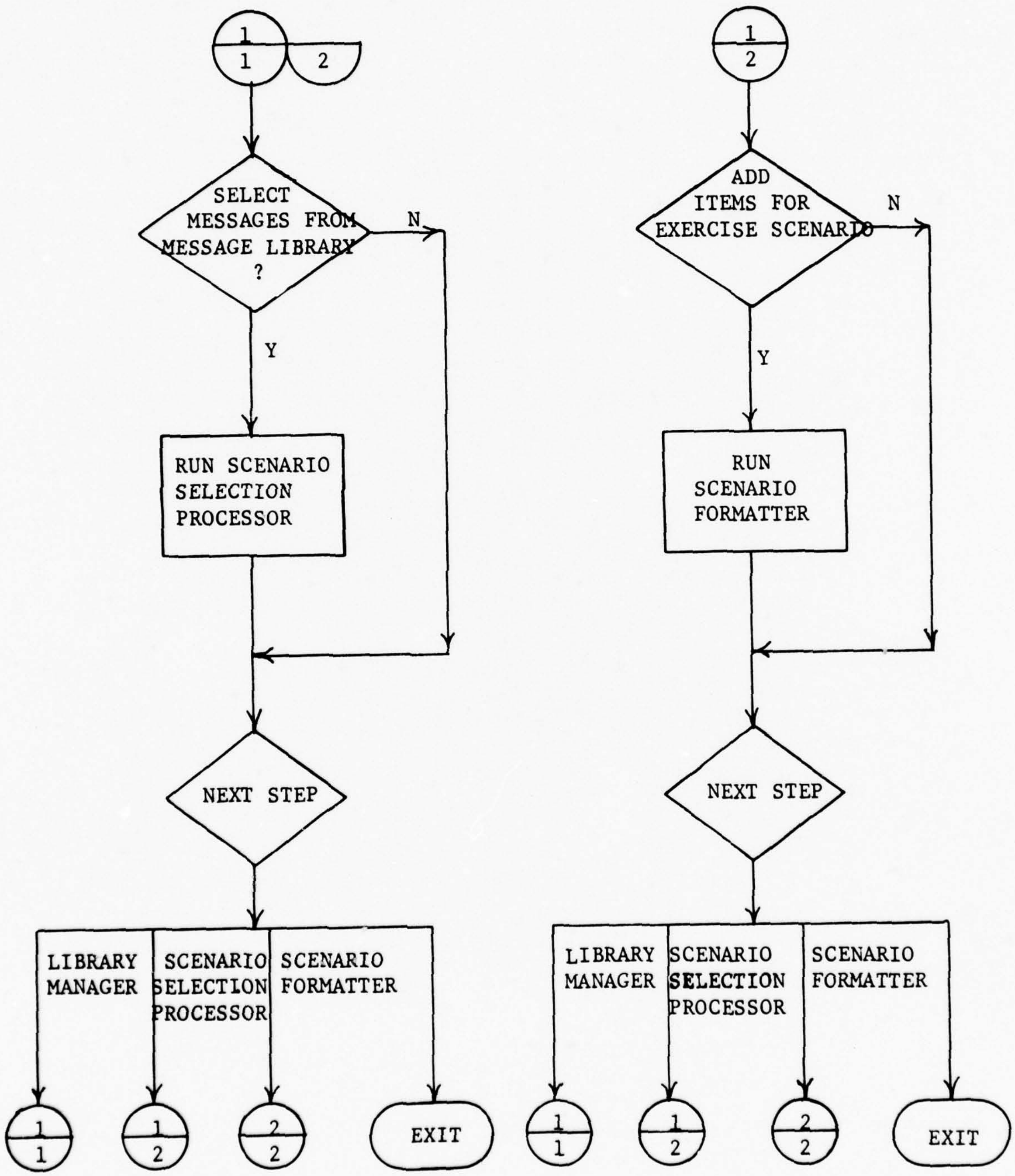


Figure 5-7. Scenario Generation Subsystem Flow
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APPENDIX A

AIPERS/SSB FUNCTIONAL DESCRIPTION

SECTION 1 GENERAL

1.1 Purpose of the Functional Description.

The Functional Description for the Automated Intelligence Processes Exercise and Review System (AIPERS) F30602-77-C-0044 as interfaced with the Standard Software Base (SSB) is written to provide:

a. The system requirements to be satisfied which will serve as a basis for user/developer understanding.

b. Information on performance constraints, preliminary design, and user impact, including fixed and continuing costs.

c. A basis for the system implementation and system tests.

1.2 Project References.

a. Demonstration Utility Prototype of Automated Intelligence Processes Exercise and Review System, Interim Program Documentation, INCO, INC., March 1976, Unclassified.

b. Automated Intelligence Processes Exercise and Review System, Functional Specifications and Prototype Development, Final Report, INCO, INC., June 1976, Unclassified.

c. AIPERS as an SSB Training Mechanism, Technical Memo 1089/9, INCO, INC., June 1977, Unclassified.

d. AIPERS Exercise System Design, Technical Memo 1089/8, INCO, INC., June 1977, Unclassified.

e. AIPERS Memory Requirement, Technical Memo 1089/10, INCO, INC., July 1977, Unclassified.

f. AIPERS Overlay Structure, Technical Memo 1089/3, INCO, INC., March 1977, Unclassified.

g. Common Users Baseline for the Intelligence Community: Overview, INCO, INC., September 1977, Unclassified.

h. SSB Installation Manual, INCO, INC., October 1977, Unclassified.

i. SSB Programmers Manual, INCO, INC., October 1977, Unclassified.

j. SSB System/Subsystem Program Specification, INCO, INC., Unclassified.

k. SSB Interim Technical Report, INCO, INC., August 1977, Unclassified.

l. AIPERS Program Documentation, INCO, INC., January 1978, Unclassified.

m. Subsystem Specifications for Scenario Generation, INCO, INC., December 1977, Unclassified.

SECTION 2 SYSTEM SUMMARY

2.1 AIPERS Background.

In response to DoD directives requiring intelligence units to be exercised as other military units and in cooperation with Rome Air Development Center, INCO has developed the Atuomated Intelligence Processes Exercise and Review System (AIPERS) Demonstration Utility Prototype (DUP). This initial exercise system is aimed at training analysts by simulating crisis situations, meeting one of the three objectives of the operational AIPERS system. These objectives are to provide analyst training in both crisis management and operating procedures, evaluate analyst procedures, and determine the adequacy of ADP support, specifically examining excessive time delays and adequacy of facilities. In addition to the capability provided by the actual exercise system, automated procedures have been developed to aid in scenario generation and will be developed to aid in post-exercise evaluation.

The overall implementation objective of the current AIPERS effort is to establish an enhanced exercise capability which will serve as demonstration software and provide a solid basis for proceeding toward an operational system. This project will provide the software basis for development toward an operational design specifications for incorporating AIPERS into SSB.

Specific objectives of the current AIPERS contract are to perform the following tasks.

- Incorporate automated assists for scenario generation in the DUP.

- Commence the automation of features of decision impact analysis in the control function of the DUP.

- Develop system specifications for the scenario generation subsystem to be included in the operational AIPERS, specifically addressing message library management, scenario generation and scenario construction.

- Develop a functional description for an AIPERS/SSB analyst station.

- Conduct frequent demonstrations of the AIPERS DUP at INCO.

2.2 SSB Background.

In 1973 and 1974 the Directorate of Intelligence Data Management, Air Force Intelligence Service, Headquarters United States Air Force (AFIS/IND), conducted a survey of USAF Intelligence Data Handling System (IDHS) modernization programs. The USAF programs involved implementation of the AN/GYQ-21(V) system as either a stand-alone, front-end, or communications processor. All program development planning featured some form of systems software, many of which were common to one another. To eliminate redundancy in the various development efforts and to realize both cost avoidances and cost savings, AFIS/IND formulated a program to develop a Standard Software Base (SSB) which would provide: common system software for AN/GYQ-21(V) users, basic communications networking software capabilities, a series of file handling services, terminal device interface capabilities, and a series of software gateways for access to external files, data bases, systems, and networks.

The overall objective of the Standard Software Base (SSB) is to provide a common inventory of modular software tools which will enable AN/GYQ-21(V) system users to quickly and effectively develop and implement data communications interfaces and to enhance the implementation of unique command/agency/activity applications.

2.3 Objectives.

The implementation objective of this effort is to merge the AIPERS exercise subsystem with the Standard Software Base.

The resulting system will meet the following two objectives:

a. Provide crisis management training.

b. Serve as a tool in terminal operation and procedure training for SSB.

A primary objective of any exercise system design is to work within the analyst environment using the usual terminal procedures, formats, data bases and communications links. Complicating the achievement of this objective is the requirement to avoid interference with other analysts at work on their operational tasks. This requirement equates to isolating the exercising analyst(s) so that exercise output and input messages do not get into the operational distribution systems. In order to effectively evaluate current procedures and provide analyst training, the testing environment must be one with which the analyst is familiar or needs to be familiar. Hence, it is assumed that the analyst interface, i.e., terminal procedures, is left intact.

This development effort will result in the demonstration of an automated exercise and training system within the JCS exercise system. This automated exercise system will provide greater flexibility in adapting to various software systems and will speed up the evaluation of exercise results. In addition, this exercise system will allow the user to perform a comprehensive check-out of their I&W functions and to evaluate the adequacy and thoroughness of the activities that are carried out by intelligence analysts.

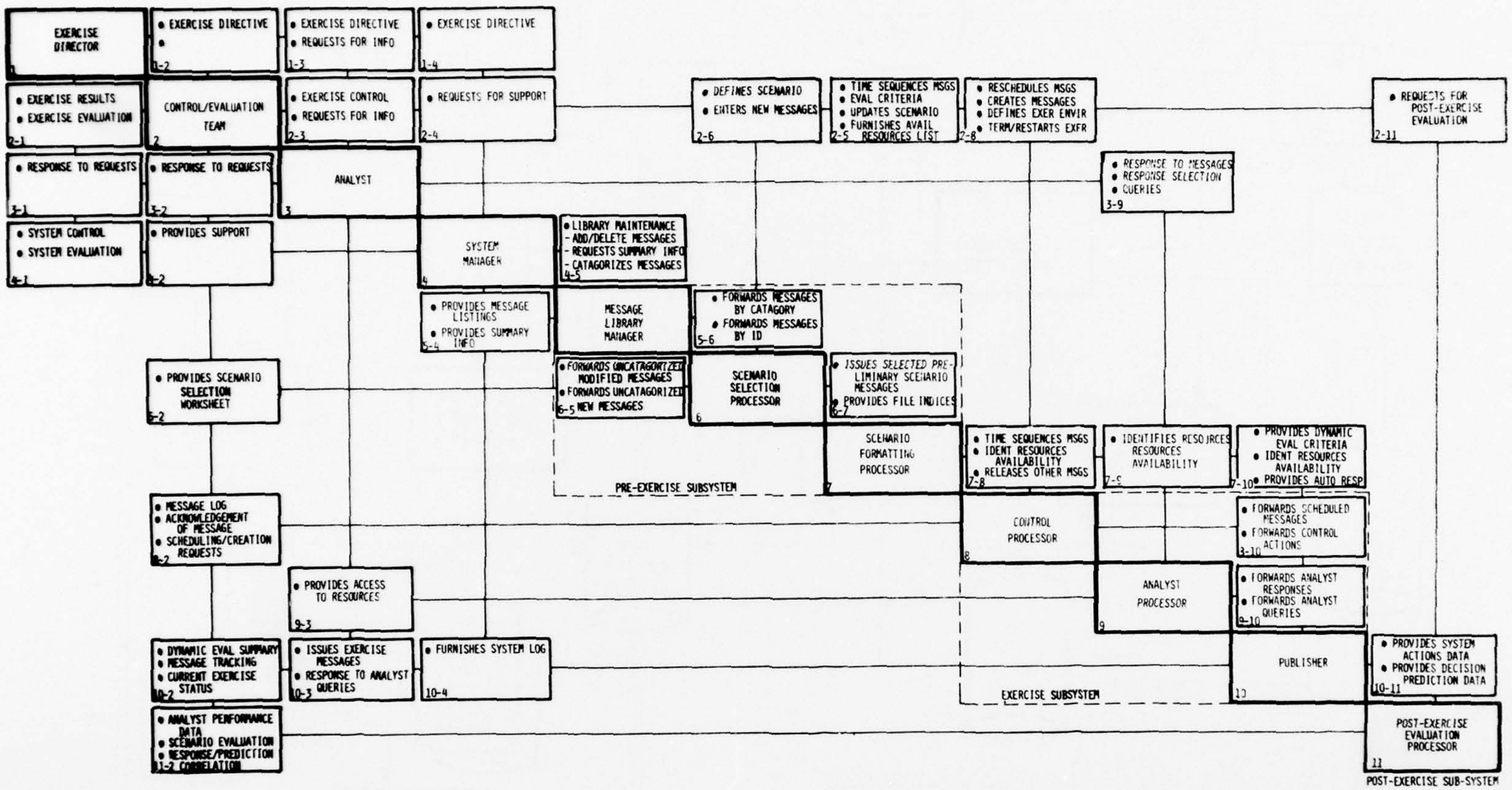

Figure A-1. AIPERS System/Flow Matrix

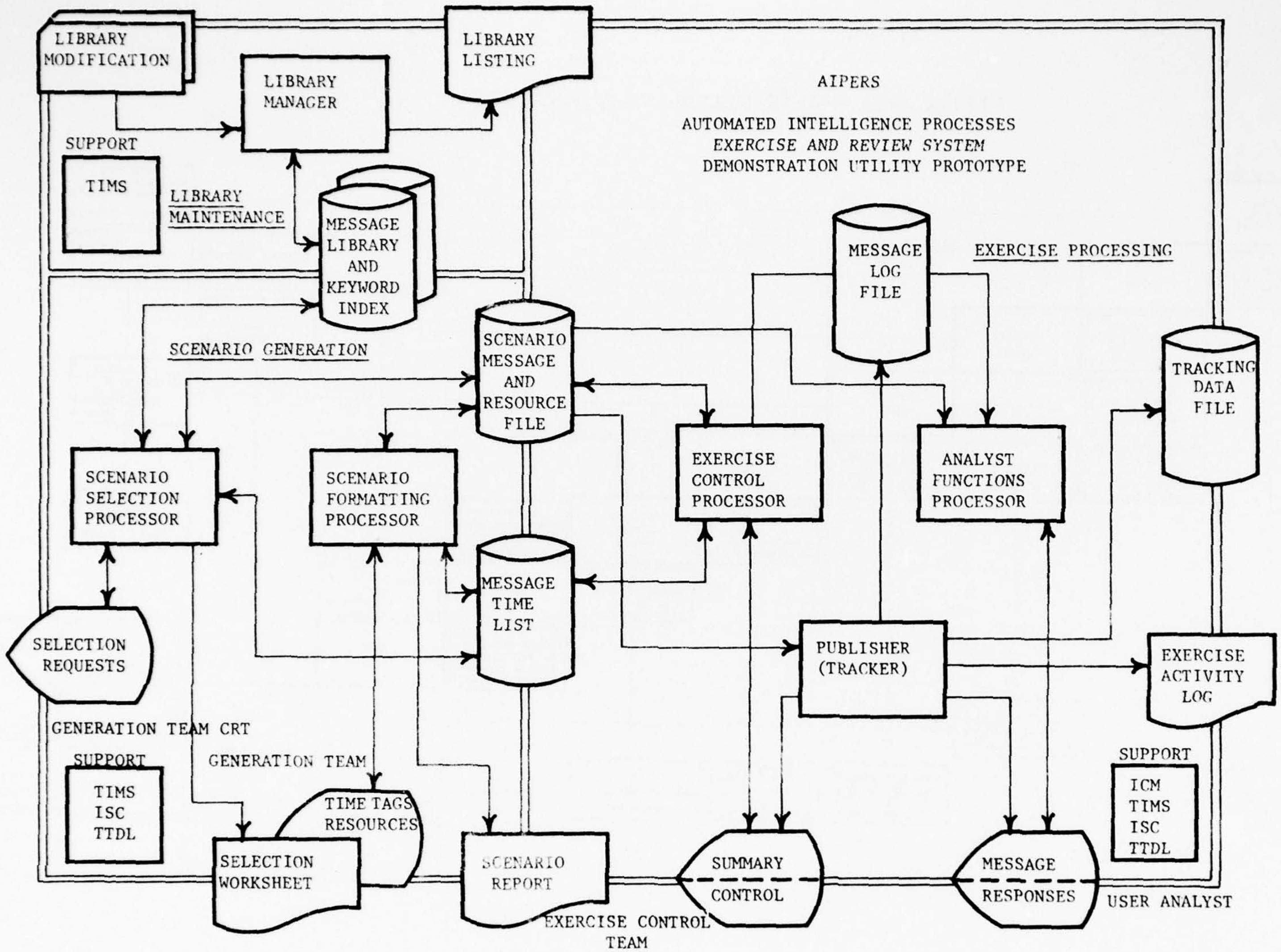

Figure A-2. AIPERS System Overview

2.4 Existing Methods and Procedures.

The following paragraphs describe the organizational/personnel responsibilities, equipment situation, and high-level system Inputs and Outputs.

a. AIPERS Personnel/System Data Flow.

The matrix of Figure A-1 shows the functional interrelationships between the enhanced AIPERS and the users, and within the AIPERS itself. The chart identifies information/data flow between nodes as well as the major system/subsystem exchanges. The system/subsystem nodes are shown along the diagonal (blocks 1 through 11). The information or data that is provided or received are shown along the horizontal or vertical axes. A block along the horizontal is an output from a node; a block along the vertical is an input. For example, the block labeled 1-3 shows that the Exercise Director issues an exercise directive to the Control Team and, in turn, the Control Team closes the informational loop by providing reports to the Exercise Director. The chart identifies the tasks that are performed but not how they are accomplished. Some of the data flow is still accomplished manually based on generated data which is manipulated by the user and then reentered either back to the sending module or to another based on the type of information/data.

A software overview of AIPERS is presented in Figure A-2. Each set of solid lines (block) outlines a function, or subsystem, which is performed off-line with respect to the other blocks. Collectively the Scenario Generation block and library maintenance block are referred to as the Scenario Generation or pre-exercise subsystem. The exercise processing block is, also, referred to as the exercise subsystem.

Each block contains a small square in a lower corner which indicates the support software required. Rectangles are used to denote modules; disks for files and the standard symbols for peripherals. Data flows are indicated by directed arrows. Further detail may be obtained by reviewing AIPERS program documentation and AIPERS related technical memoranda.

b. SSB Personnel/System Data Flow.

The key personnel associated with the SSB system are the user/analysts. In addition, SSB has published literature for a system operator and site programmers.

The selection of the RSX-11D operating system as the community standard relieved the problem of providing a common operating system to AN/GYQ-21(V) users. By retaining unchanged the vendor released versions of RSX-11D, only sub-executive level modules were required to extend its capability to accommodate development of communications networking, terminal device interface, and file handling software. Three major subsystems are evolving within the confines of the Standard Software Base to provide these essential elements of common systems software. Rome Air Development Center's Terminal Oriented Support System (TOSS) was used as the basis for the communications networking and terminal device interface software. The Storage and Retrieval Processor (SARP) was developed to provide the file handling services.

SSB provides a common inventory of modular software tools which enable system users to quickly and effectively develop and implement data communication interfaces and to enhance the implementation of site applications. Because of the modular design, only those components directly required by a given site will need to be installed at that site.

The Release 3 configuration of SSB consists of four major software components. They are the Terminal Transparent Display Group (TTDL), the Applications Modules Group, the Gateway Manager Group, and the Gateways Group. It enables the designer/programmer to develop simple or complex input and output displays for a virtual terminal display screen. TTDL's software adapts the virtual terminal's characteristics to those of any physical terminal on which a terminal application is run. The Applications Modules Group provides the I/O terminal user with a variety of message handling functions such as logging on to access the system, building and transmitting messages, and receiving and reviewing message traffic. The Gateway Manager Group interfaces all SSB application software with non-applications software. It provides centralized traffic control for the system and separates communications, terminal, and system software from each other. This separation makes possible the interface with other site-dependent systems such as CATIS. The Gateway Manager concept protects against unauthorized access to SSB capabilities and files, and also provides for automatic journalization of incoming and outgoing traffic in the system. The Gateways Group provides the actual gateways, or interfaces, between SSB and external systems such as AUTODIN, CATIS, and the DIA on-line system (DIAOLS). Figure A-3 shows the relationships between each group, as well as peripherals and users.

c. Equipment Required and Available.

This section defines the minimum hardware/software configuration required to support SSB Release 3.

The following hardware requirements are the <u>minimum</u> within which SSB will operate:

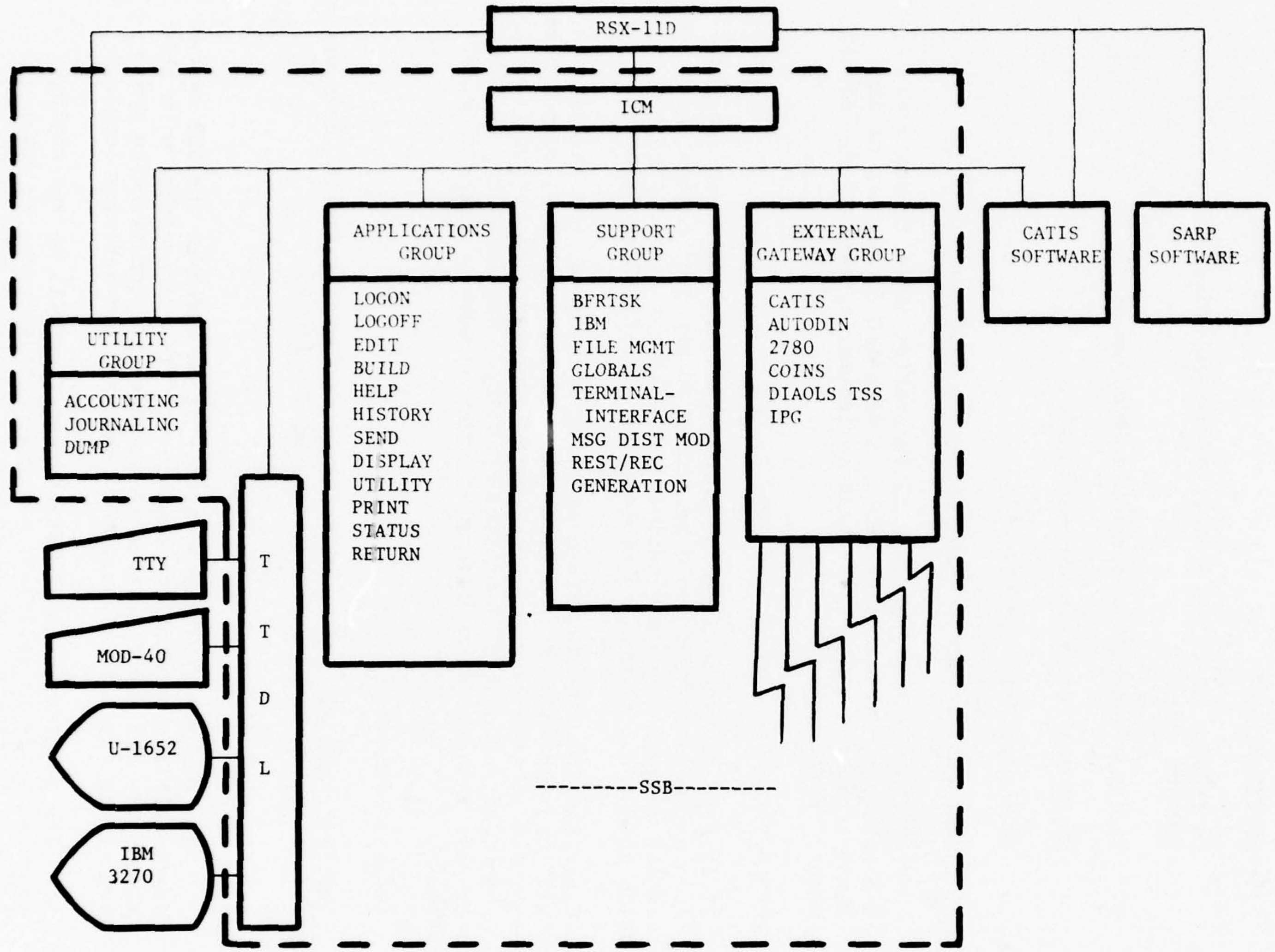

Figure A-3. SSB Release 3 System/Subsystems

AN/GYQ-21(V)

BR 1569 or DL-11 interface to Western Union PTC or Analytics TLC for AUTODIN

Teletype-compatible terminals (minimum of 1)

RP-04 disk drive (minimum of 1)

TU16 tape drive (optional)

CR11 card reader or similar device (optional)

AIPERS requires the same configuration since it now uses SSB software, particularly TTDL. A detailed discussion of the memory requirements is presented in technical memorandum, "AIPERS Memory Requirements."

2.5 Proposed Methods and Procedures

It is proposed that AIPERS be integrated into SSB as an external gateway. As a gateway messages could be routed to any destination; analysts via the terminal gateway or communications networks (or simulators) via communication gateways. Figure A-4 depicts the AIPERS/SSB architecture.

Since the SSB user interface is being maintained, the analyst processor will be superseded by the host user modules which will communicate with the exercise control gateway. The control gateway will perform the scenario scheduling and control functions handling. The remainder of SSB will also be left intact. No modifications need be made to scenario generation modules.

2.5.1 Summary of Improvements

The following paragraphs will summarize improvements in terms of new capabilities and improved capabilities and timeliness.

a. Capabilities

The primary capability which will be added to the SSB system is the ability to simulate message traffic. Associated with this capability are the functions of message file construction and sequencing, dynamic message file changes, and activity logging.

The functional capabilities resulting will be the ability to train analysts in crisis management procedures, to train analysts in terminal procedures and to provide perfomance data on the host software system in the case where a central routing structure is used in the system, e.g., SSB, WICS.

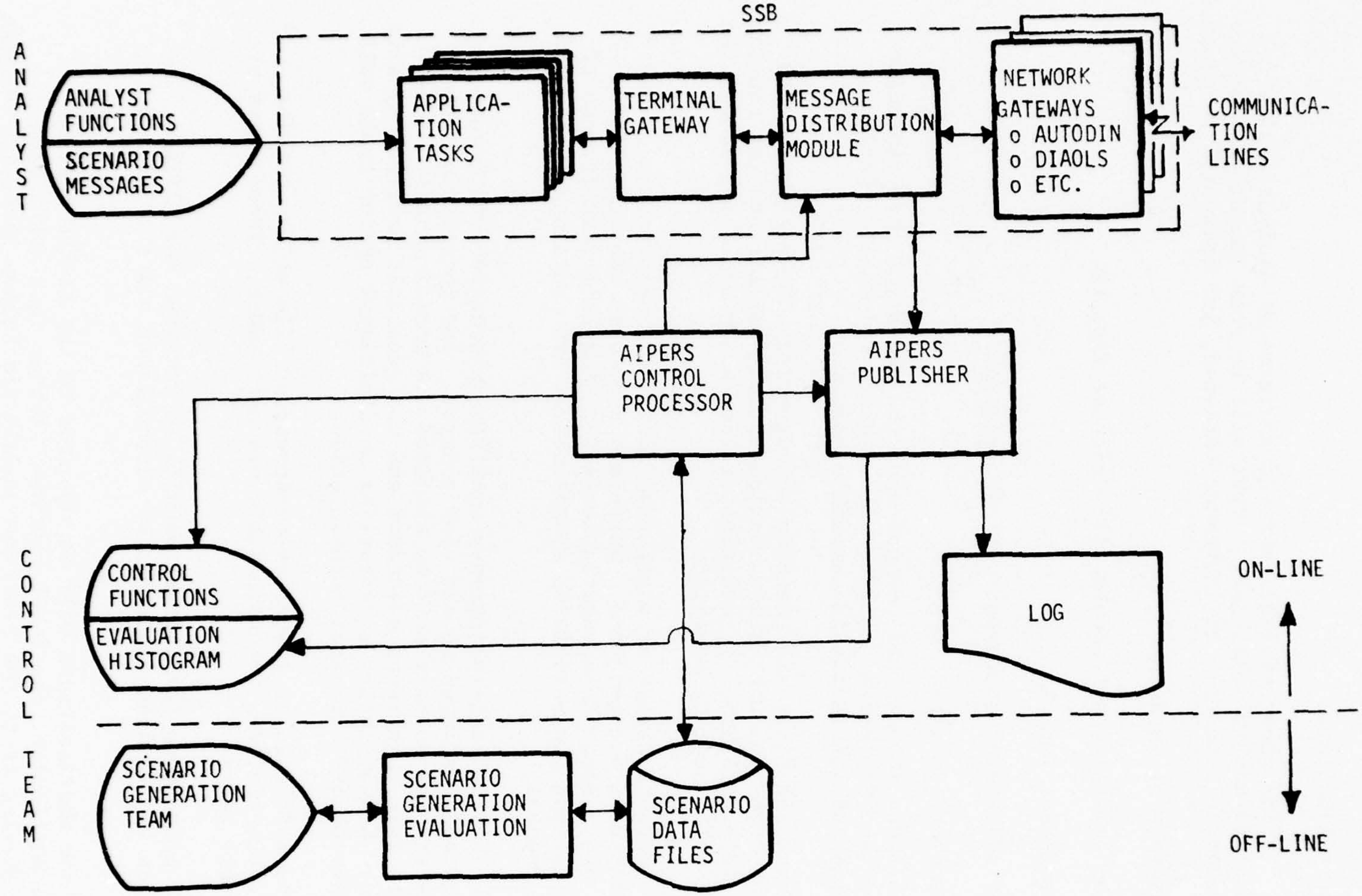

Figure A-4. AIPERS/SSB System Overview

b. Timeliness

Timeliness will be improved in terms of analyst evaluation and man-machine dialogue. There will be some impact on computer response times due to increased workload, but this will be minimal.

2.5.2 Summary of Impacts

The following paragraphs will describe impacts.

2.5.2.1 Equipment Impacts

No additional equipment will be required.

2.5.2.2 Software Impacts

Software impacts will depend upon the amount of site-dependent additions to the SSB system. AIPERS will require relatively little processor time and can reside in shareable memory.

Three SSB files will need to be augmented. These are the SSB system common (COMFIL), the Gateway Options File (GOTFIL), and the Routing Information file (RIFFIL). In addition, if new users are being added, the user file (USRFIL) must be modified.

To support AIPERS as a gateway, additional occurrences of two SSB data structures are required. These are a network characteristics table (NCT) and a Route Reference Table (RRT). Complete descriptions of these structues and the associated sysgen macros are contained in the SSB Installation Manual.

The GOTFIL contains gateway specific information which must be both obtained and displayed to the user analyst. Any information which is not to be treated as text must be obtained via modifications to the GOTFIL. This file is gateway-dependent and not generally modified by site installation. Consequently, constructing an additional option table will require review of SSB technical documentation.

The RIFFIL is an installation-dependent file which contains essential routing information accessible via user names. These names are standard to all users.

At present no initialization will be required for AIPERS. If initialization is required, this can be accomplished via the SSB module, TISINT.

Minor modifications will be required to the AIPERS control processor in particular, the ISSUE routine. Rather than retrieving a message and passing it to the Publisher module via buffer task, the message will have to be constructed as a TCF message using SSB global routines and the message distribution module will have to be notified.

The publisher will have to be modified to act as a send gateway. In addition some message interpretation logic should be added to provide a decision analysis capability. As a send gateway, the publisher will communicate with the message distribution module and the accounting module (TISAFM).

All intertask communication is via ICM macros. The two principal functions are request module (RTMR) and return status (RSTA).

2.5.2.3 Organizational Impacts

No additional personnel will be required for either system but the proposed system will require all the personnel of each of the two systems.

2.5.2.4 Operational Impacts

No major operational impacts are foreseen in terms of processing. An exercise may be run on-line with other legitimate users provided that the trainee does not interfere with concurrent traffic. Off-line exercise procedures, such as scenario generation may be performed at any time as SSB applications.

2.5.2.5 Developmental Impacts

No user developmental impact is foreseen.

2.6 Expected Limitations

Some limitations are inherent in the present exercise system. Some facets of the analyst's routine will have to be simulated and consequently may not refelct real world situations.

Since only the end product i.e., finished intelligence messages, are received by AIPERS, no evaluation or assistance can be provided with respect to terminal procedures. Possibly, some conclusions can be drawn from the elapsed time required.

Since the analyst responses to a given scenario are in the form of messages, decision analysis and post exercise evaluation will probably be only partially automated.

As mentioned earlier, if standard network synonyms are to be used and still have concurrent exercising and intelligence gathering, then the RIFFIL entries must be local to a given user.

SECTION 3. DETAILED CHARACTERISTICS

3.1 Specific Performance Requirements

Since the system is being constructed rather than improved, the requirements for the AIPERS/SSB system are of a qualitative rather than quantitative nature. The requirement is to provide an exercise system with sufficient capability to provide analyst training in routine terminal procedures as well as crisis management. In addition this exercise system should be constructed in a modular fashion to permit straightforward coupling with other major software systems.

More specific requirements are listed below.

a. The SSB site should be able to simultaneously conduct exercises and routine operations.

b. The AIPERS system must reside in shareable memory to permit normal site dependent applications to co-exist.

c. The AIPERS system must not substantially increase overhead.

3.1.1 Accuracy and Validity

The following is a summary of the accuracy and validity requirements.

a. The control processor must not permit messages to be forwarded if they are being modified in any fashion.

b. A time granularity of no more than one (1) minute is permitted with respect to message scheduling.

c. No textual examination of ad hoc messages will be performed, e.g., for code words.

d. Decision analysis information will be based solely on textual message interpretation, e.g., keywords.

e. All log entries are to have posting time from exercise start to the nearest second.

3.1.2 Timing

a. Throughput

Ninety percent of forwarded messages must have a processing delay of 10 seconds or less.

b. Priorities

Two priorities must be assigned with respect to the SSB system. The exercise control processor (includes message scheduling) should be assigned a priority greater than the publisher module (includes message interpretation and decision analysis) but less than the operational SSB system.

c. Interleaving Requirements

AIPERS memory management is largely based on overlay structures. It is appropriate to continue this approach since disk activity is presently not a constraint whereas available memory is somewhat limited. Although the control processor is time-driven (via asynchronous system traps), the time frame is minutes. So, checkpointing overhead is not a factor.

3.2 System Functions

In addition to the capability provided presently by the SSB system, the following major AIPERS functions will be added.

a. Scenario Generation Subsystem

This subsystem is used to construct or retrieve messages, time sequence the messages and provide prediction data for decision analysis. The subsystem will remain unmodified. The definition of analyst resources will be superfluous since the SSB system inherently defines its own resources. These entries are required for the current simulated analyst system. No further mention will be made of this subsystem. More details may be obtained from references l and m.

b. Message Scheduling

Message scheduling will be performed via RSX realtime services and messages will be forwarded via TISFIL to the SSB message distribution module.

c. Scenario Modification and Status Information

These control processor functions will remain largely intact. They include message review, log review, message addition, message modification, message delivery time alteration, message deletion, and exercise termination.

d. Logging

Disk and physical device (optional) logging will be continued. Log entries contain time, source, and function dependent data.

e. Message Interpretation

At present, automated evaluation (decision analysis) is simplified by rigid analyst action specifications i.e., a pre-defined menu of actions. There is a somewhat similar SSB counterpart which is exemplified in the menu task. However, the point at which AIPERS will receive responses is after all applications tasks have been requested and finished intelligence is forwarded. Thus, decision analysis will be based on keyword analysis and elapsed time.

3.3 Inputs/Outputs

Inputs and outputs are of two types, files and interactive dialog. Listed below are each major function with the associated inputs, outputs, and stored elements.

a. Message Scheduling and Scenario Modification

Inputs consist of two disk files, a hierarchical message file called the Message and Resource file (MSGRES) and the associated index file, which additionally contains run-time status, called the message time list (MTL). These files are initially produced by the Scenario Generation Subsystem and updated by the control processor as scenario modifications are requested. The resulting output is simulated messages which are forwarded in a broadcast fashion to users. Additionally a message log file (MSGLOG) is constructed and maintained. Its contents reflect the users message sequence.

Interactive inputs include requests for message text or sequence changes, status request and initial exercise definition parameters. Interactive outputs include corresponding request acknowledgments, error displays, and status displays.

b. Logging and Message Interpretation

Inputs are in the logical form of finished user intelligence and control processor action summaries. The physical input is an ICM service request block (SRB) with information sufficient to locate the appropriate logical input. For example, the user analyst input is an SRB forwarded by the terminal gateway and message distribution module which contains the message sequence number (MSN) to access the finished message. The log file (ALLLOG) and an optional corresponding hard copy listing contains the action summaries with elapsed time in chronological order.

Additionally, an exercise summary is maintained based on analysis of user analyst messages. This is in the form of a control team TTDL screen area and contains recent events, time, and user evaluation for each user analyst. If necessary, the message file will be referenced for response prediction data.

3.4 Data Characteristics

The characteristics of all files are detailed in Figure A-5. All files are presently on disk. Assuming an average scenario of 50 messages, approximately 100,000 characters of storage are required. The capacity of any present disk (cartridge or multiplatter) is therefore sufficient. Since SSB requires a multiplatter disk, unless site constraints dictate otherwise the AIPERS files will be maintained on that device.

The present anticipated response array used in decision analysis will probably be replaced with a set of keywords (dictionary) and an associated evaluation indicator. Some research will need to be performed before the exact nature of the SSB decision analysis can be formulated.

3.5 Failure Contingencies

The system is not of a critical nature. Therefore, no back-up or fallback system will be considered. To some extent the current simulation-based AIPERS can be considered a back-up or fallback system, suitable for training in crisis management.

Restart facilities are currently present to some extent in both SSB and AIPERS. These will be retained. Both SSB and AIPERS maintain system status on disk files.

FILE	DYNAMICALLY EXPANDED?	ACCESS TYPE	#RECORDS	RECORD LENGTH (CHARACTERS)	AVERAGE SPACE (CHARACTERS)
MSGRES	YES	HIERARCHICAL (KEYED)	ONE OR TWO PER MESSAGE	VARIABLE TO 2000 CHARACTERS	1800/MSG (WITH OVERHEAD)
MTL	YES	RANDOM	ONE PER MESSAGE	14	14/MSG
ALLOG	YES	SEQUENTIAL	ONE PER SYSTEM ACTION	10-20	100/MSG
MSGLOG	YES	SEQUENTIAL	ONE PER FORWARDED MESSAGE	72	72/MSG

Figure A-5. File Characteristics

SECTION 4. EQUIPMENT/SUPPORT SOFTWARE ENVIRONMENT

4.1 Equipment Environment

The equipment requirements are described in Section 2.4.

4.2 Support Software Environment

Support software is divided into two categories: development and operations. The operating system for both development and operations is DEC RSX-11D version 6B.

a. Development Software

1. MACRO-11 Assembler

2. FORTRAN IV Plus compiler

3. Standard DEC utilities

4. Biomac - Structured Language macros

b. Operations

1. TOSS Information Management System (TIMS) - Used for hierarchical file access

2. TOSS File Support - Used for flat file access

3. Intertask Communication Module (ICM) - Subexecutive used for memory sharing and task communications both with SSB and internally (within AIPERS).

4. Terminal Transparent Dipslay Language (TTDL) - Used for interactive terminal communication.

5. SSB release III

4.3 Interfaces

As mentioned earlier, the AIPERS SSB on-line system will interface with the AIPERS scenario generation subsystem via two files: The Message File and the time list file. Both are described in Section 3.3. Correspondingly the interface to any post-exercise subsystem (as for evaluation) is via files, the log file and the modified message file (see Section 3.3).

The primary interface of interest is, of course, with the SSB system. As a receive gateway the AIPERS control processor will forward a service request block (SRB) to the message distribution module via RTMR/RSTA ICM calls. Imbedded in the SRB will be the message sequence number (MSN) for the previously stored TISFIL message.

As a send gateway AIPERS will receive an SRB from MDM and forward an acknowledgment to the accounting module (TISAFM) in the form of an SRB. Again, the SRB will contain the MSN for the finished user message.

The format of all messages is TISS Common Format (TCF), in which may be imbedded network information. Figure A-6 details the previously described interfaces.

4.4 Security

It is envisioned that AIPERS will be available to unclassified personnel. At present, neither the system nor the message file contains any classified information. The BUILD function allows specification of classification level, compartment, and handling. If necessary, this information can be used to secure classified information.

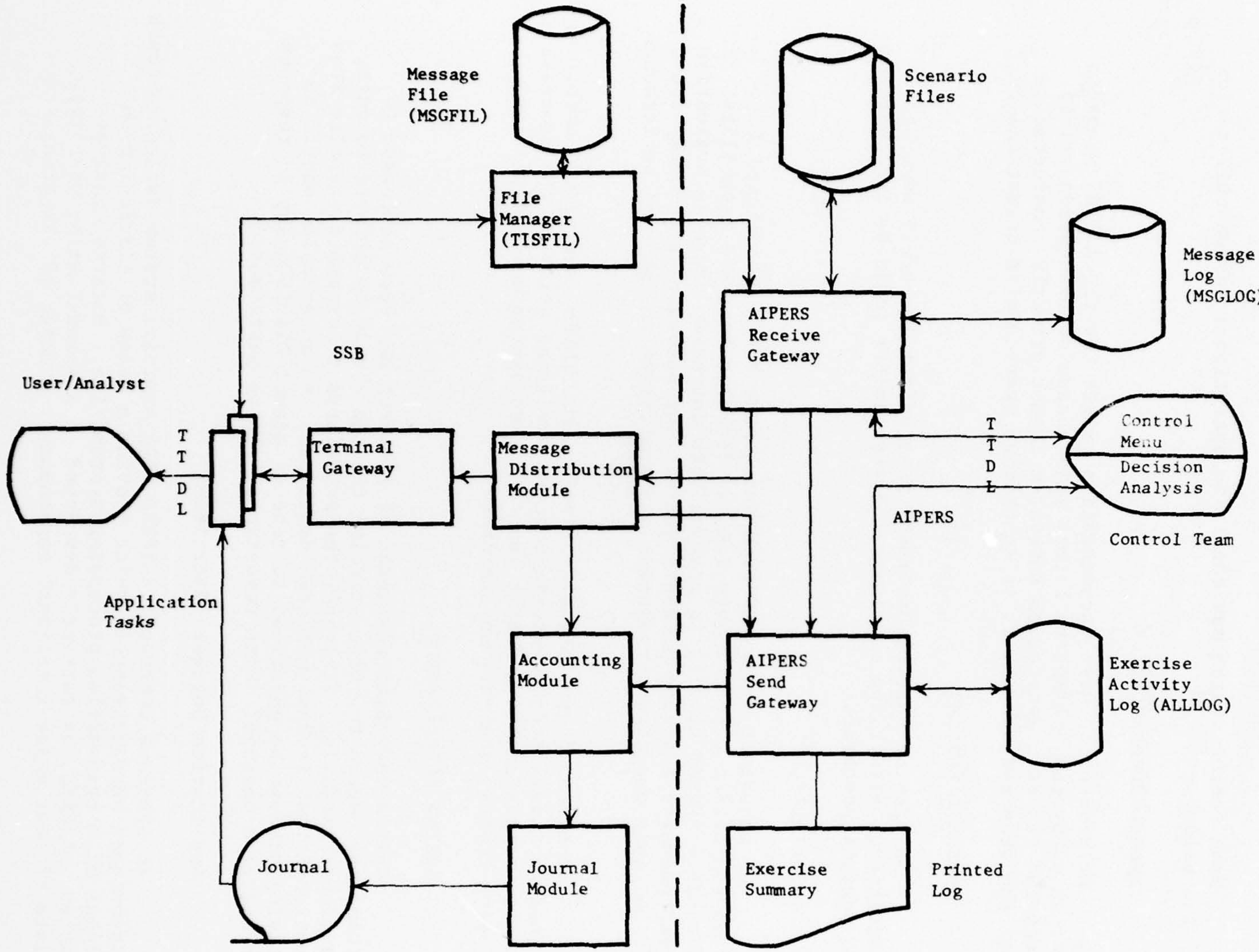

Figure A-6. AIPERS/SSB Interface

SECTION 5. COST FACTORS AND OPTIONS

Some factors which may constrain operational system utilization are listed below.

5.1 System Documentation

At present no user documentation exists for the AIPERS scenario generation subsystem. Also, no formal maintenance documentation exists. Although the scenario generation subsystem is not directly considered as part of the proposed system, it is an obvious prerequisite operationally.

5.2 Message Editing

The present control processor text editor is barely adequate. With additional effort the multiuser SSB text editor could be incorporated in the control processor.

5.3 Evaluation

No manual or automated procedures have been established for exercise evaluation beyond a very limited decision analysis capability. It would enhance system utility to provide both automatic exercise evaluation and comprehensive exercise planners guide. The automated procedures would permit multiple exercise correlation and statistics and general performance data.

In order to evaluate effectively particularly during the exercise, some goals and evaluation criteria must be specified prior to the exercise. So, a more comprehensive scenario generation subsystem would assist in developing clearly goal-driven exercises.

5.4 System Interference

Only a very limited amount of research has been performed to determine the degree to which exercise traffic should be allowed to enter conventional channels. Likewise, the procedures to separate exercise from conventional traffic have not been developed. As an example, should an exercising analyst be permitted to make an actual DIAOLS query in response to an exercise message? More research should be performed.

5.5 Application Software Exercising

In previous contracts (AIPERS R&D) exercise system design concepts and techniques were developed, which provide a means of simulating one component of a transaction processing system, i.e., external analyst resources. AIPERS, as currently developed in a demonstration prototype, consists of four major functional components: a means of preparing and disseminating a scenario of messages; a control capability; a logging facility; and a user analyst interface for stand-alone development. With the exception of the user analyst interface, all of the above functional components are required in a software exercise system; a means of preparing and disseminating the normal dialogue between the simulated source and the host system is required; control is required because of the possibility of failures in prerequisite actions; and a tracking mechanism is required for compilation of non-automated measurement. In addition, an adaptable target system interface is required so that performance measurements can be made.

With relatively little modification, because of the design of SSB with a central routine mechanism and standard gateway interfaces, the control processor developed under the proposed system could be used to test new gateways. Particularly, high-speed and peak-volume loading could be tested without the need for constructing special driver programs.

SECTION 6. DEVELOPMENT PLAN

The plan for system development is given in the form of tasks, and a GANTT chart indicating deliverables and manpower requirements are presented in Figure A-7.

6.1 Tasks

1. Review SSB technical documentation, in particular, system/subsystem specifications, installation manual, programmer manual, and users guide.

2. Perform an SSB system generation including AIPERS tasks as Send and Receive gateways.

3. Design and code modifications to the AIPERS control processor message issuing logic so that it conforms to SSB receive gateway procedures.

4. Design and code modifications to the AIPERS Publisher so that it conforms to SSB send gateway protocol.

5. Design and code modifications to the AIPERS Publisher to perform decision analysis based on finished messages and elapsed time.

6. Customize the present scenario to provide adequate system testing, then integrate and test the system.

7. Demonstrate the system in actual environment conditions to determine training effectiveness and measure system degradation.

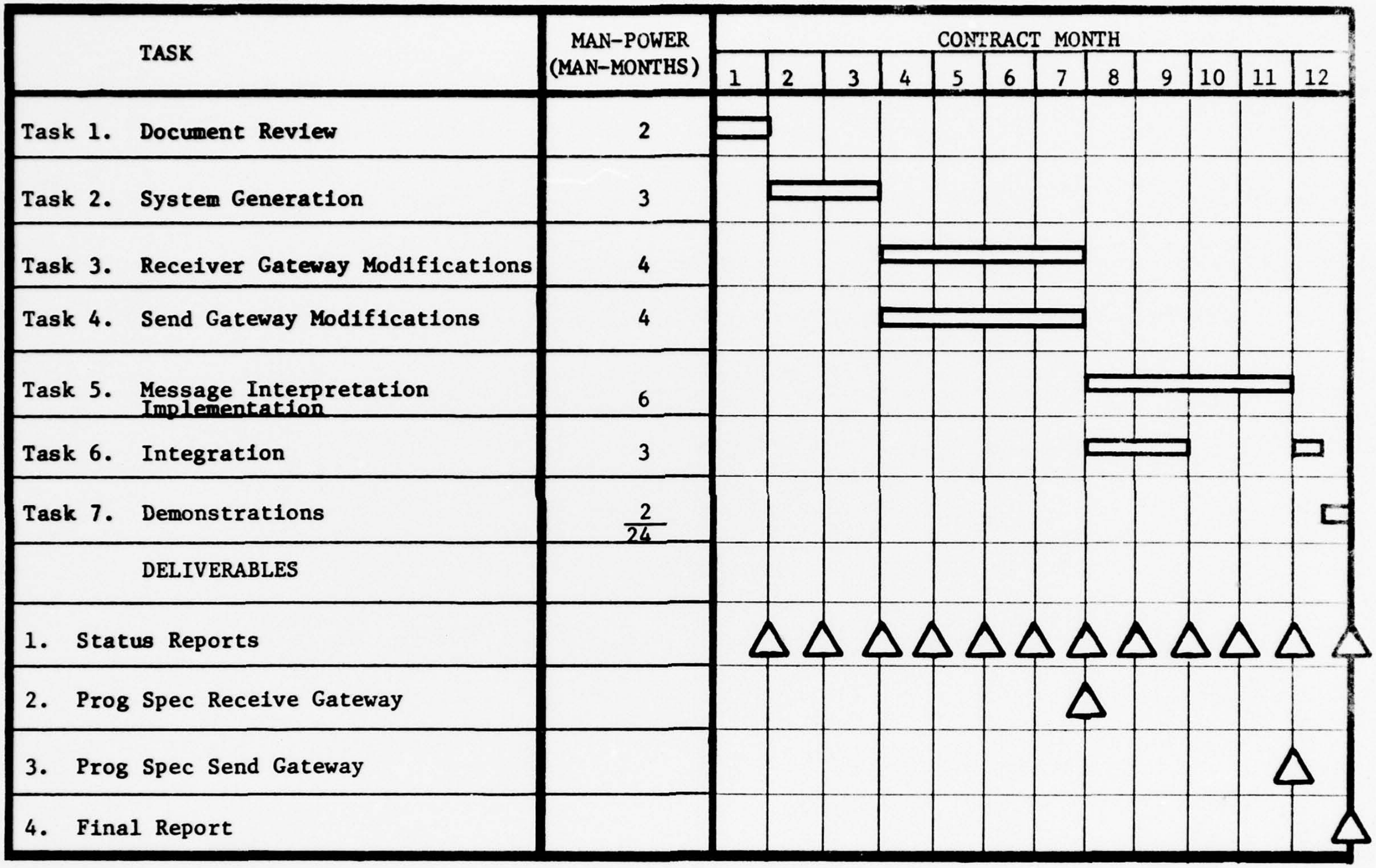

Figure A-7. GANNT chart for AIPERS/SSB Syste.

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